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LITERATURE SURVEY OF SOLID WASTE/ DISEASE RELATIONSHIPS. VOLUME III. ANNOTATED BIBLIOGRAPHY. PART 2

T. G. Hanks

Aerojet-General Corporation

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Public Health Service

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VON KARMAN CENTER

LIFE SYSTEMS DIVISION

LITERATURE SURVEY OF SOLID WASTE/DISEASE RELATIONSHIPS

VOL. III - ANNOTATED BIBLIOGRAPHY, PART 2

FINAL REPORT TO

OFFICE OF SOLID WASTES
UNITED STATES PUBLIC HEALTH SERVICE

CONTRACT PH 86-66-151

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LITERATURE SURVEY OF SOLID WASTE/DISEASE RELATIONSHIPS

VOL. III - ANNOTATED BIBLIOGRAPHY, PART 2

By T. G. HANKS, M. D.

Final Report To

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
BUREAU OF STATE SERVICES
UNITED STATES PUBLIC HEALTH SERVICE
OFFICE OF SOLID WASTES

Contract PH 86-66-151

Report No. 3337 January 1967

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ERRATA (Vol. III, Annotated Bibliography, Part 2)

DSW NO.	
221	Second line should read: clouds, other than....
225	First line should read: ...dispose of the chemical residues from....
241	Author: S. H. Ash, *et al*.
314	Page 2, line 18 should read: ...that adequate composting of faecal....
319	Page 3, 4th paragraph, 2nd line should read: ...arthropod containing the metacyclic trypanosomes.... Page 6, paragraph 5, 1st line, should read: On non-enteric infections....
324	Page 1, last line should read: ...represents primarily a veterinary.... Page 4, 2nd paragraph, 6th line should read: ...containing glue on the labels....
330	First line: delete "annotated bibliography" and insert abstract.
360	Remove "and F. F. P. S. Glasg" from Author
381	Line 4 should read: ...processes foreign animal.... Line 5 should read: ...anthrax in foreign feeds,....
386	Page 5, sixth line from bottom should read: ...as they now occur....

**Disease/Solid Waste
Abstracts**

No. DSW-220

Author

Hugh S. Pylant

Title

Here's How Petrochemical Companies

Dispose of Wastes

Reference

Oil & Gas Journal, Nov. 4, 1963

Doc. No.	Contract No.	Date issued
p. 118		

Abstract

Spent caustic is sent to a disposed well.

Wash water and spent caustic from the butadine section are collected and pumped into the disposal well. After precipitation of the copper, supernatant liquid is pumped to the disposal well.

To eliminate toxicity problems, spent caustic and dilute CAA solutions (treated with caustic and steam) are pumped to a disposal well at a rate of 50-80 gpm and 1,600 psig. The well is over 4,000 ft deep and is cemented almost all the way to the bottom.

Oily water flows to an API separator and is discharged to the effluent ditch. Separated oil is pumped to a slop-oil tank, decanted, and then burned for fuel.

The wastes are recycled about six times and then continue to the activated-sludge system for oxidation of remaining organics. The wastes are then chlorinated and discharged to the effluent ditch.

The pungent odor of green [illegible] both in normal and oxidized states, causes another pollution problem. A very disagreeable odor is noticed downwind of the furnace stack during the steaming and burning-off periods. The possibility of installing a catalytic combustion unit to insure complete combustion and eliminate the odor problem is under study.

Considerable stabilization of the organic content of cooling water and treated waste takes place in the ditches through action of algea and other biological life.

Descriptors

petrochemical
disposed well
decanted
organics
odor
wastes
toxicity
burned
chlorinated
catalytic combustion unit
spent caustic
oil
activated-sludge
pollution

Disease/Solid Waste
Abstracts

No. DSW-221

Author
H. L. Green and W. R. Lane

Title
Particulate Clouds: Dusts, Smokes
and Mists

Reference
D. Van Nostrand Co., Inc. 1957

Doc. No. **Contract No.** **Date issued**
General & Industrial Chemistry Series

Abstract

Two broad types of harmful effects arising from the inhalation of particulate chouds, other than microbiological aerosols, may be distinguished, the first being systemic and the other localized in the respiratory system. Suspensions which act as systemic poisons or cause loss of function, such as lead dusts or certain pesticides, are less size-dependent than where only the respiratory system is concerned and the problem of their study is comparatively simple. The other type of effect is caused by the inhalation of dust and gives rise to a group of diseases known as the pneumoconioses, which comprise by far the largest number of cases of respiratory illness directly attributable to industrial particulates. There is also a smaller group coming under the heading of pneumonitis, a form of pneumonia caused by metals such as manganese, vanadium, cadmium and beryllium.

Dusts which are potentially dangerous in causing respiratory disease are created in a wide variety of industries. Examples where mineral dusts are created are the grinding, foundry, pottery, silica, and firebrick, asbestos, quarrying, and, above all, the coal and gold mining industries. Organic dusts of harmful nature are formed in the cotton, flax and hemp industries, but the list is much shorter than for inorganic dusts, although the number which may cause minor effects is extensive. To the organic dusts may be added pollens and varioud dusts derived from fur, feathers, carpet sweepings, etc., which may cause allergic conditions. Also there are many combustion products and other atmospheric pollutants which, in varying degrees, may contribute to ill health.

Pneumoconiosis is a general description for a diagnosable disease of the lungs produced by the inhalation of dust, the term "dust being understood to refer to particulate matter in the solid phase, but excluding living organisms. Various terms have been applied to signify diseases due to specific dusts: silicosis due to

Descriptors

particulate clouds
inhalation
manganese
beryllium
foundry
firebrick
coal
cotton
pollens
carpet sweepings
silicosis
siderosis
explosions
chemical industry
cement dust

microbiological aerosols
pneumoconioses
vanadium
respiratory disease
pottery
asbestos
gold mining
flax
fur
allergic conditions
byssinosis
accidents
combustible dusts
coal mining industry
sulphuric acid mists

poisons
pneumonitis
cadmium
grinding
silica
quarrying
organic dusts
hemp industries
feathers
asbestosis
bagassosis
dust fires
dust clouds
air pollution
iron and zinc oxide smokes

Abstract (continued)

dust containing free silica, asbestosis caused by breathing asbestos dust, byssinosis produced by the dust formed in the preparatory processes in cotton spinning mills, bagassosis from the grinding of bagasse (sugar cane without sugar), and siderosis occurring amongst welders and haematite miners. These distinctions are sometimes difficult to maintain, especially when the dust is of a mixed character, and it is often preferable to refer to the disease as a pneumoconiosis coupled with the associated industry, e.g., coal miners' pneumoconiosis.

Microbiological aerosols usually exert their infectivity through the respiratory system and this is one of the main avenues for the transmission of disease. Here again the sizes or degree of aggregation of organisms are important.

An entirely different kind of hazard is created by the explosive and flame propagating properties of certain organic dusts which have led to many fatal accidents in industry. Fortunately, such accidents are only liable to occur when the concentration of the particulate matter is very high.

Dust fires and explosions in the presence of a source of ignition are dependent on a number of factors which, following Thom and West (1948), may be cpnsidered under a number of different headings:-

(a) Materials - Typical combustible dusts may be derived from (i) natural materials, e.g., wood, resins, paper, rubber, drugs, sugar, coal, starch, (ii) synthetic materials, e.g., dyestuffs, plastics, hexamine, and practically all carbon compounds, and (iii) inorganic material, e.g., sulphur, iron, magnesium, aluminium and zirconium.

(b) Sources of ignition - Flame arises from accidental fires and operations involving the use of flame, from radiant heat ignition, and from sparks arising from electrical apparatus, static electrification and the presence of ferrous metal and flints in materials being processed. Furthermore, a minimum temperature must be attained before ignition can take place (Gibbs, 1924, p. 166).

Static electrification is of special interest because it is associated with the properties of the cloud itself. It has already been shown that high electrostatic charges can be produced in dusts by frictional effects such as blowing the dust through a tube. If the surface density of the charges on the dust particles exceeds $3 X 10^{-9}$ coulombs/cm^2, then the breakdown strength of the air may be exceeded and a brush or spark discharge may occur and lead to ignition of the cloud. The conditions under which ignition of dust clouds by electrostatic discharge takes place have been discussed by Cox and Pearce (1948) in a comprehensive paper.

(c) Dispersion of dust in air. - For an explosion to occur in a dust-air mixture, the dust concentration must lie within certain limits. In Table 10.10 above are limiting figures quoted from Garside (1948).

Particle size plays a large part in dust explosions, the finer the dust the greater is the liability to explosion. Work on this aspect has been done also by Garside (1948).

(d) Moisture content - High moisture content of the dust and a high relative humidity of the air can prevent ignition and consequent explosion. The presence

Abstract (continued)

of moisture is of obvious importance in preventing static electrification and the transmission of flame.

Dust clouds are produced in the preparation and handling of materials mentioned above and stringent precautions have been taken to prevent explosions with their consequent danger to operatives and damage to plant and buildings. These follow the general principles of prevention of ignition, isolation of machines in which a hazard may exist and the provision of explosion reliefs (Matheson, 1948). Precautions adopted in the chemical industry have been described by Thom and West (1948), and in the coal mining industry by Tideswell (1948) with special reference to the admixture of inert materials (stone-dusting) to prevent propagation of flame.

Air pollution in chemical industry has provided many cases where the emission of particulates has created a nuisance or health hazard and has called for investigation of the nature and properties of the clouds thus produced. Examples are cement dust, sulphuric acid mists, iron and zinc oxide smokes, and various fluorine compounds.

Analysis of the organic constituents of the suspended particles has, however, received attention during the past few years in view of their possible carcinogenic potency. Determinations by Cooper (1953) of the hydrocarbons in atmospheric pollution in Salford have yielded the following average results:

Hydrocarbon	ppm deposit	$\mu g/100\ m^3$ of air
Anthracene	15 to 30	0.75 to 2.0
Pyrene	320 to 500	20 to 40
Fluoranthene*	400	20
3:4-benzpyrene	220 to 400	15 to 30
1:12-benzperylene	230 to 460	15 to 35

* One determination only

Of the compounds found, 3:4-benzpyrene is the most interesting since it is highly carcinogenic. It has been suggested that atmospheric pollution containing this substance is an adjunct in the causation of lung cancer.

...Sulphur dioxide and its oxidation products caused the injurious effects in the Meuse Valley, but no particular contaminants were incriminated at Donora, although all the evidence suggested that the effects were produced by the synergistic action of two or more contaminants (Schrenk and others, 1949).

By contrast with the other two incidents, data well summarized by Wilkins (1954), are available for the concentration of smoke and sulphur dioxide in the air during the London smog of 1952.

The emission of particles of noxious materials from industrial plant has given rise to many problems....difficulties which arise in connection with the

Abstract (continued)

treatment of large volumes of gas containing only a small concentration of a noxious or offensive contaminant. Examples are the waste gases arising from the smelting of low sulphur-bearing ores, and steel melting processes where traces of fluorine compounds are present, and the air vitiated in all types of ventilating plants. In such cases, there is seldom the prospect of recovering any by-product of value and the cost of extracting or destroying the offensive constituent may be altogether prohibitive, so that recourse must be made to discharge through stacks at such a height that no harmful effect is likely to be produced at ground level.

Descriptors (continued)

health hazards
3:4-benzpyrene
contaminant
fluorine compounds
sulphur dioxide
waste gases
carcinogenic
synergistic action

TABLE 10.1

Deaths from all types of pneumoconiosis in England and Wales, 1940–1951

(McLaughlin, 1955)

Industry	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	Total
Potteries	53	45	47	41	32	41	49	54	48	63	73	62	608
Sandstone . . .	109	82	54	77	57	65	61	55	68	51	29	71	779
Grinding of metals, etc. .	41	26	26	21	24	22	32	27	26	37	22	21	325
Refractories . . .	16	12	7	7	6	9	8	10	13	13	8	8	117
Miscellaneous . . .	7	5	7	5	13	19	14	26	27	25	70	129	347
Coal mining . . .	232	196	230	276	311	387	421	577	639	756	846	937	5,808
Other mining . . .	64	40	46	43	39	40	51	50	49	64	42	51	579
Asbestos	11	17	11	8	10	11	16	15	15	17	12	18	161
Cotton (byssinosis) . .	—	—	6	7	1	10	3	4	8	7	11	8	65
Total	533	423	434	485	493	604	655	818	893	1,033	1,113	1,305	8,789
Non-occupational . .	650	461	443	493	531	529	568	616	651	554	679	732	6,907

7<

Abstract (continued)

TABLE 10.3

Threshold limits for toxic dusts, fumes and mists

Substance	mg/m³	Substance	mg/m³
Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanonaphthalene)	0·25	Malathion (0,0-dimethyl dithiophosphate of diethyl mercaptosuccinate	15
Ammate (ammonium sulphamate)	15	Manganese	6
Antimony	0·5	Mercury	0·1
Arsenic	0·5	Mercury (organic compounds)	0·01
Barium (soluble compounds)	0·5	Methoxychlor (2,2-di-*p*-methoxyphenyl-1,1,1-trichloroethane	15
Cadmium oxide fume	0·1	Molybdenum (soluble compounds)	5
Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane	2	(insoluble compounds)	15
Chlorinated diphenyl oxide	0·5	Parathion (0,0-diethyl 0-*p*-nitrophenyl-thiophosphate)	0·1
Chlorodiphenyl (42% chlorine)	1	Pentachloronaphthalene	0·5
Chromic acid and chromates (as CrO_3)	0·1	Pentachlorophenol	0·5
Crag herbicide (sodium 2-[2,4-dichlorophenoxy] ethanol hydrogen sulphate)	15	Phosphorus (yellow)	0·1
Cyanide (as CN)	5	Phosphorus pentachloride	1
2,3-D (2,4-dichlorophenoxyacetic acid)	10	Phosphorus pentasulphide	1
Dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8,-dimethanonaphthalene	0·25	Picric acid	0·1
Dinitrotoluene	1·5	Selenium compounds (as Se)	0·1
Dinitro-o-cresol	0·2	Sodium hydroxide	2
EPN (O-ethyl O-*p*-nitrophenylthionobenzenephosphonate)	0·5	Sulphuric acid	1
Ferrovanadium dust	1	TEPD (tetraethyl dithionopyrophosphate)	0·2
Fluoride	2·5	TEPP (tetraethyl pyrophosphate)	0·05
Hydroquinone	2	Tellurium	0·1
Iron oxide fume	15	Tetryl (2,4,6-trinitrophenylmethylnitramine)	1·5
Lead	0·15	Titanium dioxide	15
Lindane (hexachlorocyclohexane, gamma isomer)	0·5	Trichloronaphthalene	5
Magnesium oxide fume	15	Trinitrotoluene	1·5
		Uranium (soluble compounds)	0·05
		(insoluble compounds)	0·25
		Vanadium (V_2O_5 dust)	0·5
		(V_2O_5 fume)	0·1
		Zinc oxide fume	15
		Zirconium compounds (as Zr)	5

TABLE 10.10

Lower inflammable limits of combustible dusts

Combustible dust	Lower limit g/litre	Combustible dust	Lower limit g/litre
National Straight Run Flour	0·052	Dried Milk 'A'	0·094
Glucose (100%, < 60 I.M.M.)	0·225	Dried Milk 'B'	0·103
National No. 1 Cattle Food	0·30	Potato Flour	0·225
National No. 1 Poultry Food	0·272	Soya Flour	0·066
Wheatings	0·150	Common Xylonite	0·024
Palm Meal Extract	0·281	Xylonite, intermediate grained	0·038
Starch, 'A'	0·098	Xylonite, plain best translucent	0·031
Starch, 'B'	0·059	Coal, S.W. Red Vein seam	0·74
Sugar F.I. 900	0·066	Coal, Silkstone seam	0·141
Gum Dust	0·094		
Cocoa	0·103		

Notes: 1. Starch 'A' contained some borax, whereas Starch 'B' was pure maize starch.

2. The difference between the samples of dried milk was one of particle size distribution. Thus, the normal [illegible] container held approximately 10 oz of sample 'A', but only some 6 oz of sample 'B'.

8<

Disease/Solid Waste
Abstracts

No. DSW- 222

Author

Uhl T. Mann and Guy E. Griffin

Title

Cost of Safety

Reference

February 1964

Doc. No.	Contract No.	Date issued

J. Water Poll. Con. Fed., Vol 36, No. 2. p.168

Abstract

The handling and mixing of ingredients for the manufacture of explosives could be considered to be an extremely hazardous operation. Yet, an injury frequency rate of 2.5 for this industry, published a few years ago (1), compares with the figure of 32.9 for sewer departments (1).

...A list of accidents published (3) shows that, although explosions were involved in 73 percent of the accidents considered, they caused only 39 percent of the fatalities. Asphyxiation, however, while account for only 20 percent of the accidents, caused 61 percent of the deaths. Thus, it would seem that lack of oxygen and/or the presence of poisonous gases is more calamitous than the presence of an explosive mixture.

Too often, the loss of life is the result of disregarding instructions for safe procedures and failing to use available safety equipment.

Summary and Conclusions

Safety in operations is not costly to obtain. To attain this very desirable end, it does require expenditure of much time and energy and usually a small amount of money. The return on the investment is large and can be measured in lowered frequency rates of accidents translated into less lost working time. Measurement of money dividends on expenditures for safe design is difficult, but some examples of the cost of accidents and the cost of measures to prevent recurrence give evidence that the value of preventing loss of life and property damage can be very real and substantial.

Descriptors

safety
property damage
explosions
safety equipment
safe design
hazardous operation
asphyxiation
loss of life
accidents
poisonous gases

---

(1) Anon., "California Water Insurance Rates Drop." Cast Iron Pipe News (Feb.-Mar. 1959).

(3) "Safety in Wastewater Works." Manual of Practice No. 1, Water Pollution Control Federation, Washington, D.C. (1959).

**Disease/Solid Waste
Abstracts**

No. DSW-223

Author

M. Jack Snyder

Title

Properties and Uses of Fly Ash

Reference

Battelle Tech. Rev., Feb. 64, Vol. 13 #2

Doc. No.	Contract No.	Date issued
p. 14		

Abstract

Fly ash, the fine particles of ash that are suspended in the combustion gases, must be separated from the gases before they are discharged to the atmosphere. Concern about air pollution and the tremendous increase in power consumption have combined to accelerate the production of fly ash and to increase the severity of the problem of disposing of the collected material. In 1959, the world production of fly ash was estimated to be of the order of 100 million metric tons (see Table, page 15) with the United States constibuting 15 million metric tons of the total.

...The problem of fly ash disposal and utilization, in the main, involves pulverized-coal-fired plants. Most of the ash produced in stoker-fired, cyclone-fired plants, and wet-bottom pulverized-coal-fired plants is accumulated as slag that can be used as an aggregate or fill material.

Electrostatic collectors, more efficient in removing the finer particles, are used by plants in heavily populated areas. In many plants, a combination of mechanical and electrostatic collectors has been found to give more efficient removal of both the combustible and noncombustible components of the fly ash.

Because of the numerous production and collection variables, fly ash is a complex, heterogeneous material exhibiting wide variation in chemical and physical properties. The range of variability in the chemical and physical properties. The range of variability in the chemical composition of the fly ash from coals in the United States is illustrated by the data in the table on page 17.

...As much as 75 to 85 percent of the ash passes through the furnace and into the stack as small discrete particles. Many of the particles exist as small, hollow spheres of fused or partially fused silicate glass or as small solid spheres of fused silicates, iron oxide or silica, and are accompanied by particles of unburned carbon and mineral fragments.

Descriptors

air pollution
electrostatic collectors
silica
entrained-air
mineral
ceramic products
disposal
fused silicates
concrete
admixtures
filler
mineral filler
utilization
iron oxide
concrete products
soil stabilization
lightweight aggregates
fertilizer

Abstract (continued)

The problem of disposing of fly ash has been given wide attention for a number of years. This is attested by a recent study for the Edison Electric Institute, wherein approximately 430 published research reports on uses for fly ash were located for the period 1930-1962. Although the effort devoted to the problem has led to some applications of demonstrated usefulness, the full utilization of fly ash has been held back by lack of concerted research and development activity and by the obvious variability of the product.

It is probable that more fly ash has been sold for use in concrete and concrete products than for any other application. Use of fly ash as an ingredient of concrete has been investigated and advocated for a number of reasons: (1) possible pozzolanic action; (2) to supply needed fine material in fines-deficient mixes; and (3) to lower the cost of concrete without harm to essential properties.

Most samples of fly ash lower the water requirements for concrete mixes resulting in a number of benefits, the more important being greater ultimate strength, decreased segregation of components of the mix, and lowered permeability. Other benefits that are often found include lowered rate of heat generation (which is important in decreasing thermal stresses in mass concrete construction such as large dams), improved resistance to mild corrodants such as sulfate solutions, and improved workability and ease of placement.

The addition of fly ash to concrete mixes, particularly when it is added as a replacement for more than about 10 percent of the cement, lowers the early strength of the concrete mix.

A deleterious effect that has received considerable attention is the lowering of the entrained-air content resulting from adding fly ash to concrete made with air-entraining cement or admixtures.

It has been assumed generally that the addition of fly ash does not harm the freezing and thawing resistance of the concrete if its air content is maintained at the proper level, but there is much conflicting evidence on this point.

...Considerable attention has been given to the use of fly ash in precast concrete products, in cement grouts used for sealing oil wells and porous formations, and as a raw material in the manufacture of portland cement.

Research on lime-fly ash soil stabilization has demonstrated that admixture of lime and fly ash with some soils and soil aggregates, can provide a base course that has substantial strength, good resistance to freezing and thawing, and satisfactory resistance to wetting and drying.

A substantial market has been developed in some areas of the United States for fly ash as a mineral filler in bitumastic road construction.

Lightweight aggregates can be made by sintering fly ash (7).

It has been shown that a variety of ceramic products can be made from fly ash and clay or shale. ...Use as a ceramic raw material does not appear to be a widely practicable way of disposing of large quantities of fly ash (8).

Fly ash has been suggested for use: as a mineral filler in putty, caulking compounds, paints, soap, fertilizer, floor tile, plastics, phonograph records, paper, and rubber; as a soil conditioner and fertilizer; as a source of germanium and gallium; and as an abrasive and a buffing compound.

Abstract (continued)

RANGES OF CHEMICAL COMPOSITIONS OF U.S. COAL ASH AND FLY ASH

Constituent	Range, Per Cent by Weight Coal Ash	Fly Ash
Silica, SIO_2	20 to 60	34 to 48
Alumina, AL_2O_3	10 to 35	17 to 31
Iron Oxide, FE_2O_3	5 to 35	6 to 26
Calcium Oxide, CAO	1 to 20	1 to 10
Magnesium Oxide, MGO	0.3 to 4	0.5 to 2
Sulfur Trioxide, SO_3	1 to 12	0.2 to 4
Unburned Materials	-	1.5 to 20

---

(7) C. M. Weinheimer, "Factors Relevant to the Conversion of Fly Ash into a Lightweight Aggregate," Paper No. 61-WA-265, presented at the ASME meeting New York, New York, November 1961.

(8) Donald J. Bowers and M. Jack Snyder, "Fly Ash as a Raw Material for Structural Clay Products," Am. Ceram. Soc. Bull., V. 37, p. 220, 1958.

Disease/Solid Waste
Abstracts

No. DSW-224

Author

E. S. Shannon

Title

Handling and Treating Petrochemical

plant wastes: a Case History

Reference

Water & Sewage Works, May '64, pp. 240

Doc. No.	Contract No.	Date issued

Abstract

The refinery complex operates under an earlier order which restricts the discharged waters to contain not more than 5 lb per cay of phenol, 15 ppm of oil, and the pH to be between 5.8 and 10.3. These restrictions on the refinery wastes are being met by very tight in plant control and treatment of process waters in standard A.P.I. separators.

The sewers are separated into uncontaminated cooling water, process water, sanitary sewage, chemical wastes, sewers which can receive copper compounds, and surface run-off.

Process wastes, consisting of about 250 gpm, are pre-treated in an A.P.I. separator equipped with a pre-aeration step of about 15 minutes retention time. The pre-areation step helps to break oil emulsions, separates carbon from oil and strips lighter hydrocarbons from the water waste. About 40 percent of the total COD load to the waste treatment plant is removed by this preaeration step. These process wastes consist of excess quench water from the cracking area and a water phase from the Hydeal plant containing benzene, toluene, xylene, and methanol.

A third stream...containing dissolved hexane, catalyst, and alcohols is added to the waste flow following pH adjustment and settling in a pond.

The combined wastes are pumped over one or two biological oxidation towers.... The mixed liquor from the activated sludge tank is pumped over the filter where considerable oxidation of the activated sludge takes place by endogenous respiration. In this type of operation the two filters remove the major portion of the organic load.

The activated sludge step is followed by final settling and chlorination.

The raw waste to the waste treatment unit consists of about 150 gpm of excess quench water, Hydeal plant, and polyethylene plant wastes, with an initial

Descriptors

process waste
oil
chemical wastes
carbon
toluene
hexane
biological oxidation towers
organic load
caustic waste
disposal well system

petrochemical
refinery wastes
process wastes
hydrocarbons
xylene
catalyst
activated sludge
settling
air stripping
floating polymer

phenol
A.P.I. separators
oil emulsions
benzene
methanol
alcohols
endogenous respiration
chlorination
carbon sludge

Abstract (continued)

COD of about 2,000 ppm, phenol about 50 ppm, and an odor threshold of over 4,000,000 dilutions.

After chlorination the final effluent contains an average BOD less than 10 ppm, phenol less than 0.01 ppm and an odor threshold less than 1,000 dilutions and usually less than 350 dilutions.

About 5,000 gpd of caustic waste from the ethylene purification and butadiene plants are not amenable to biological treatment and, together with spent caustic and phenol containing wastes from the refinery, are also pumped to the disposal well system.

Oil which is skimmed from the A.P.I. separators is pumped to a slop oil decanter tank.... Prior to the installation of the air stripping step in the process water A.P.I. separator, considerable tar-like material was causing malfunction of the interface control and difficulty in skimming oil. Since air stripping has been introduced, the carbon from this tar-like material is settling to the bottom of the separator. The settled carbon sludge and floating polymer are removed periodically from the A.P.I. by use of a vacuum truck.

Disease/Solid Waste
Abstracts

No. DSW-225

Author

Louis Klein, et al

Title

River Pollution. II. Causes and Effects

Reference

Butterworths - London, 1962

Doc. No.	Contract No.	Date issued
pp. 24		

Abstract

Pollution may be solid or liquid, and if liquid, may contain dissolved material or suspended matter as well as dissolved gases of a pulluting character.

Solid pollution may consist of any kind of solid material, such as sand, gravel, soil, ashes, cinders, clinkers; sweepings from any factory, mine, quarry, or house; any sludge or solid sewage matter; any vegetable or other garbage; offal or parts of the carcase of any animal; rubber, wood, paraffin wax, gelatine, straw, paper or paper pulp, and even bread and butter.

The commonest form of pollution causing the most trouble to river authorities, however, is liquid (which includes solids in suspension).

Chemical pollution, due to the presence of organic or inorganic substances, is, in general, the commonest type of pollution and the most intractable.

This extremely common form of pollution is due to the presence of proteins, fats, carbohydrates and other organic substances and materials found in sewage and trade wastes.

Proteins are nitrogenous organic substances of high molecular weight found in the animal and vegetable kingdom and consisting wholly or partly of very large numbers of amino acids....

Examples of proteins are egg albumin, gelatine (found in bones and other animal tissues), keratin (present in wool), fibroin (present in natural silk), casein (found in milk), and glutenin (present in wheat). Under the influence of bacteria and other micro-organisms, proteins readily undergo putrefaction giving chiefly amino acids, fatty and aromatic acids, and numerous organic bases.... Many of these decomposition products have very objectionable odours. Excreta and fresh sewage are said to owe their unpleasant small largely to the presence of small amounts of indole and its methyl derivative, skatole....

Descriptors

pollution
sludge
chemical pollution
carbohydrates
bacteria
excreta
slaughterhouse wastes
edible oil
laundry wastes
paint manufacture
rubber manufacture
phenols
coal gas
cyanides
epidemics

solid
solid sewage matter
proteins
organic substances
micro-organisms
trade wastes
dairy wastes
fat refining wastes
sewer sludge
linoleum
tar
toxic
organic chemicals
DDT
gastro-enteritis

solid pollution
solids in suspension
fats
amino acids
putrefaction
canning wastes
tannery wastes
wool scouring wastes
textile wastes
lacquers
coal-tar
synthetic detergents
insecticides
biological pollution
influenza

Abstract (continued)

Among the trade wastes containing proteins are food processing and canning wastes, gelatine and size manufacturing wastes, slaughterhouse wastes, dairy and tannery wastes. The grossly polluting character of all these is due in no small degree to their protein content.

Fats-Although insoluble in water, fats dissolve in such organic solvents as petroleum, chloroform and ether.

Fats occur in sewage and in such industrial wastes as wool scouring wastes; edible oil and fat refining wastes, wastes from soap manufacture and launcry wastes.

Holroyd (11) has suggested that to ensure complete extraction of fatty material in sewage sludges, without including the metallic components, acid treatment with hydrochloric acid, which will hydrolyse the soaps to free fatty acids, followed by extraction with petroleum, ethyl ether, or chloroform, gives consistent results whichever solvent is used.

Soaps are found in sewage, sewage sludges (especially in sedimentation tank sludge), laundry wastes and textile wastes. Waxes are present in waste waters from the scouring of wool and in certain paper and textile wastes.

Carbohydrates-are compounds of carbon, hydrogen, and oxygen, which are widely distributed in the animal and vegetable kingdom. They include the simple sugars, such as glucose, ...sucrose,...as well as the more complex high molecular weight polysaccharides....such as starch, dextrin, glycogen, alginic acid and cellulose. Starch and dextrin are used in paper making and in textile printing, and are therefore sometimes found in paper and textile waste waters.

Resins-...are complex compounds of carbon, hydrogen and oxygen....Resins are also used in the manufacture of linoleum, in paint manufacture, in the textile industries, and in the preparation of lacquers.

Rubber-...is found in wastes from rubber manufacture and processing and from the waxing of paper.

Coal-...is present in finely divided form in effluents from coal-washing plants and is a common form of pollution in rivers in mining districts....

Oil-...may come from barges, tankers, and boats on rivers or canals, or may be derived from industrial wastes, metallurgical industries, engineering works, garages, or indeed any trade premises using lubricating oils or fuel oils....

Tar-is produced by the destructive distillation of coal, peat, wood, bituminous shale and other naturally occurring organic materials.

The most important tar from a pollution standpoint is coal-tar....Tar, in view of its content of such toxic substances as phenols...and organic bases...is an extremely dangerous form of pollution in a river and its presence causes destruction of bacteria, fish and other aquatic life.

Many thousands of organic compounds...may be objectionable because they are toxic.

Synthetic detergents-... cause foam on rivers and at sewage plants...They also reduce the rate of re-aeration of river water...adversely affect the efficiency of sewage purification plants...may cause tastes in water supplies...and are toxic to aquatic flora and fauna....

...The natural detergents exhibit very greatly reduced toxicity in hard water...synthetic detergents show the same toxicity in distilled water and in hard water.

Many trade wastes (e.g. wastes from the manufacture of coal gas, organic chemicals, and insecticides) contain poisonous organic compounds (such as phenols, tar bases, cyanides and DDT) which not only have the objectionable property of

Abstract (continued)

killing bacteria and so rendering a river sterile and unable to undergo self-purification, but also in quite low concentrations can cause mortality amongst fish and other aquatic life.

Many industrial wastes contain corrosive inorganic acids or alkalis which can do extensive damage to a stream.

The commonest toxic inorganic substances are free chlorine, chloramines, ammonia, hydrogen sulphide and soluble sulphides....

Biological pollution is often a secondary result of pollution by sewage or trade wastes.

Olson (215) states that certain blue-green algae are toxic to human beings and animals, and can cause epidemics of gastro-enteritis.

Many of the common infections of man (e.g., influenza, smallpox, poliomyelitis and yellow fever) are virus diseases and consequently the possibility of virus contamination of our rivers must not be overlooked. Piliomyelitis virus has been detected in the stools of patients suffering from the disease and in the stools of healthy carriers as well as in sewage during an epidemic of the disease (222, 223).

Experiments carried out in South Africa (224) have demonstrated the presence of the virus in raw sewage sludge, settled sewage, septic tank effluent, and in humus tank effluents, but not in sewage sludge digested for 30 days or in a sand filter effluent. Thus, humus tank effluent could contaminate streams with the virus and if used for irrigation might contaminate vegetables or fruit. Russian workers (230) suggest that sewage might well be of importance in the spread of poliomyelitis since they observed a preponderance of cases near rivers receiving discharges of sewage.

It is unusual for trade wastes to contain pathogenic organisms but tannery wastes may contain the very resistant spores of anthrax bacilli derived from hides (30). Wastes from slaughterhouses and from dairies handling tuberculous animals may contain tubercle bacilli (234).

Sewage...contains living matter, especially bacteria, viruses and protozoa.

Bacteria are present in sewage and farm drainage in very large numbers (several millions per millilitre). Most sewage bacteria are relatively harmless and belong to the class of "saprophytic" bacteria (i.e., bacteria which only feed upon dead organic matter). A few are, however, dangerous since they belong to the class of pathogenic" bacteria (i.e., those which cause disease in man and animals) and are, therefore, important from a public health standpoint.... Among the most important of the pathogenic bacteria liable to cause infection in this country are Salmonella typhi (causing typhoid fever), Salmonella paratyphi (causing gastro-enteritis (241,242), Shigella dysenteriae (causing bacillary dysentery), and Vibrio cholerae (causing cholera, but now very rare in Great Britain).

Pathogenic organisms have been detected in sewages from various countries and it has also been shown that conventional treatment (e.g., sedimentation followed by aerobic biological process) does not remove all the pathogens.... Sewage from hospitals and sanatoria treating tuberculous patients may contain tubercule bacilli and thus have to be chlorinated for complete safety (234).

The predominant bacteria in sewage and river waters belong to the coliform group, and hence these organisms, though harmless in themselves, are used as test organisms in order to determine whether a water is safe bacteriologically....

The discharge...of sewage, slaughterhouse wastes, dairy wastes and many other organic trade wastes often causes excessive growths of so-called "sewage fungus"... the commonest is the filamentous bacterium Sphaerotilus natans....

Abstract (continued)

Conditions favouring the growth of Sphaerotilus are the presence of organic matter (e.g. carbohydrate-containing, textile finishing, paper mill, sugar refinery, distilerry, brewery and dairy wastes)....

Harmful Effects of Sewage and Trade Wastes - Corrosive substances (acids, alkalis) or toxic substances (e.g. cyanides, phenols, zinc, copper, etc) may kill fish, bacteria, and toher awuatic life, anaimal and vegetable. The resulting destruction of beneficial water bacteria may product a sterile river whcich is unable to undergo natural self-purification. Such water may prove dangerous to use for domestic purposes or for watering cattle.

Pathogenic micro-organisms may be discharged with sewage during epidemics (page 86). Trade wastes, as a rule, are free from pathogens, though anthrax bacilli may possibly occur in tannery wastes.

Abstract (continued)

Table 1. Types of pollution in sewage and trade wastes

A. Chemical	*B. Physical*	*C. Physiological*	*D. Biological*
Organic (carbon compounds)	Colour	Taste	Bacteria (pathogenic)
Inorganic (mineral compounds)	Turbidity Temperature Suspended matter Foam Radioactivity	Odour	Viruses Animals Plants

Table 5. Some typical alkaline and acid waste waters

Alkaline Wastes

Waste	pH	*Alkali(s) present*
Gas liquor	8–9	Ammonia
Kier liquor (kiering of cotton or straw)	12–14	Caustic soda, sodium carbonate, lime
Cotton mercerizing wastes	12–14	Caustic soda
Chemical manufacturing wastes	variable	Caustic soda, sodium carbonate, lime, ammonia
Tannery wastes	up to 12	Lime
Wool scouring wastes (untreated)	9–10	Sodium carbonate

Acid Wastes

Waste	pH	*Acid(s) present*
Mine water	2·5–6·5	H_2SO_4
Battery factory wastes	1·0 or less	H_2SO_4
Iron pickle liquor	strongly acid	H_2SO_4, sometimes HCl, rarely H_3PO_4
Copper pickle liquor	strongly acid	H_2SO_4
DDT wastes	very strongly acid	H_2SO_4
Viscose rayon wastes	strongly acid	H_2SO_4
Wood pulp spent sulphite liquor	2–4	Sulphurous acid (H_2SO_3)
Chemical manufacturing wastes.	variable	H_2SO_4, HCl, HNO_3, H_3PO_4
Munition factory wastes	1–3	H_2SO_4, HNO_3
Wool scouring wastes ('cracked' with acid)	<4	H_2SO_4

Abstract (continued)

Table 20. Types of industrial waste waters[234]. From M. B. Ettinger, by courtesy of *Water and Sewage Works*

A. WASTES CHIEFLY MINERAL IN NATURE, OR PARTLY MINERAL AND PARTLY ORGANIC

1. Brine wastes
2. Mineral washing slurries and suspensions (e.g. stone sawing, sand and china clay washing)
3. Mine drainage (pit water from coal mines)
4. Pickle liquor wastes (e.g. iron and copper pickling, galvanizing, etc.)
5. Electro-plating
6. Water softening
7. Cooling water from condensers
8. Boiler blow-off
9. Inorganic chemical manufacturing wastes
10. Battery manufacture
11. Coal-washing
12. Inorganic pigments
13. Photographic wastes

B. WASTES CONTAINING CHIEFLY ORGANIC MATERIALS

I. Hydrocarbon wastes

1. Oil wells
2. Petroleum refining
3. Styrene manufacture
4. Co-polymer rubber plants
5. Butadiene plants
6. Natural rubber processing or reclaiming
7. Petrol stations, garages, engineering works

II. Miscellaneous organic chemical wastes

8. Munition plants (e.g. TNT, Tetryl, ammonium picrate, etc.)
9. Synthetic pharmaceuticals
10. Synthetic or man-made textile fibres (e.g. rayon, nylon, etc.)
11. Organic chemical manufacture
12. Paints and varnishes
13. Oil and grease processing and refining

III. Phenolic wastes

14. Gas plants and by-product coke plants
15. Tar distillation, road oil and creosoting plants
16. Chemical plants
17. Synthetic resin plants
18. Wood distillation
19. Dye manufacturing

IV. Biological wastes

(a) Wastes from processing of biological materials and/or from biological processes

20. Tanneries and leather trades
21. Pharmaceuticals (antibiotics, biologicals; e.g. penicillin)
22. Alcohol industries (brewing and distilling)
23. Miscellaneous fermentation industries
24. Glue, size and gelatine plants
25. Wool scouring
26. Textile manufacture (natural fibres; e.g. cotton, wool, silk, flax)
27. Floor-cloth manufacture
28. Paper manufacture
29. Laundries

(b) Food processing wastes

30. Canneries
31. Meat packing, slaughterhouse and related trades
32. Milk and dairy wastes
33. Corn products plants
34. Beet sugar factories
35. Cane sugar factories
36. Fish processing plants
37. Other food processing and dehydration plants

(c) Farm wastes (e.g. piggeries)

Abstract (continued)

Table 21. Some chemical substances in industrial wastes

Substances	*Present in waste waters from*
Free chlorine	Laundries, paper mills, textile bleaching
Ammonia	Gas and coke manufacture, chemical manufacture
Fluorides	Scrubbing of flue gases, glass etching, atomic energy plants, fertilizer plants, metal refineries, ceramic plants, transistor factories
Cyanides	Gas manufacture, plating, case-hardening, metal cleaning
Sulphides	Sulphide dyeing of textiles, tanneries, gas manufacture, viscose rayon manufacture
Sulphites	Wood pulp processing, viscose film manufacture, bleaching
Mineral acids	Chemical manufacture, mines, iron and copper pickling, D.D.T. manufacture, brewing, textiles, battery manufacture, photoengraving
Acetic acid	Pickle and beetroot manufacture, acetate rayon
Citric acid	Soft drinks and citrous fruits
Organic acids	Distilleries, fermentation plants
Tartaric acid	Dyeing, wine making, leather manufacture, chemical works
Alkalis	Cotton and straw kiering, wool scouring, cotton mercerizing, laundries
Chromium	Plating, aluminium anodizing, chrome-tanning
Lead	Battery manufacture, lead mines, paint manufacture
Nickel	Plating
Cadmium	Plating
Zinc	Galvanizing, zinc-plating, viscose-rayon manufacture, rubber-processing
Copper	Copper-plating, copper pickling, cuprammonium rayon manufacture
Arsenic	Sheep-dipping, fellmongering
Silver	Plating, photography
Hydrogen peroxide	Peroxide bleaching of textiles, rocket motor testing
Sugars	Dairies, breweries, preserve manufacture, glucose and beet sugar factories, chocolate and sweet industries, wood processing
Starch	Food processing, textile industries, wall-paper manufacture
Fats, oils, and grease	Wool scouring, laundries, textile industries, petroleum refineries, engineering works
Phenols	Gas and coke manufacture, synthetic resin manufacture, textile industries, tanneries, tar distilleries, chemical plants, dye manufacture, sheep dipping
Formaldehyde	Synthetic resin manufacture, penicillin manufacture
Mercaptans	Oil refineries, pulp mills
Tannic acid	Tanning, sawmills
Nitro compounds	Explosives factories, chemical works
Hydrocarbons	Petro-chemical and synthetic rubber factories

Abstract (continued)

Table 28. Some synthetic toxic organic chemicals used as herbicides and insecticides

Commercial or common name	*Chemical name*	*Use*	*Remarks*	*Approximate harmful concentration to fish.* p.p.m.	*Reference (see end of chapter)*
2:4-D	2:4-dichlorophenoxyacetic acid	Herbicide	Used for weed control. Toxic to non-grassy plants	500* (sunfish and catfish) 1,500* (minnows)	69
Santobrite	Sodium pentachlorophenate	Herbicide	Controls broad-leaved weeds	0·2	70
”	”	”	”	0·04 (minnows)	71
DDT	2:2-bis-(*p*-chlorophenyl)-1:1:1-trichloroethane	Insecticide	Kills flies and mosquitoes. Controls flies at sewage works filters	>0·1 (goldfish)	72, 73
BHC (gammexane)	γ-hexachloro*cyclo*hexane (γ-isomer of benzene hexachloride)	Insecticide	Kills flies and mosquitoes. Controls flies at sewage works filters	0·035	74
Toxaphene	Chlorinated camphene	Insecticide	One of the most toxic insecticides	About 0·005 (trout)	75, 76
TEPP	Tetraethyl Pyrophosphate	Insecticide		0·25	75
Aldrin	Hexachloro-hexahydro-dimethano-naphthalene	Insecticide	A highly toxic compound	About 0·02	76
Parathion	O:O-diethyl O-*p*-nitrophenyl thiophosphate	Insecticide	Effective against a wide range of insects and mites	About 0·2 (bluegills)	75

* Maximum safe concentration.

Descriptors (continued)

smallpox
virus
humus tank
pathogenic organisms
protozoa
public health
shigella dysenteriae
sanatoria
sphaerotilus natans
distillery
poliomyelitis
settled sewage
sewage sludge
anthrax bacilli
farm drainage
salmonella typhi
vibrio cholerae
coliform
paper mill
brewery
yellow fever
septic tank effluent
tannery wastes
tubercle bacilli
"saprophytic" bacteria
salmonella paratyphi
hospitals
sewage fungus
sugar refinery

Disease/Solid Waste Abstracts

No. DSW-226

Author

W. A. Darrah

Title

Methods of Dust and Fume Disposal

Reference

Industrial Heating, Vol. 23, 1960, pp. 70

Doc. No.	Contract No.	Date issued

Abstract

Fumes may be either gases, vapors, or solids or some combination of these states, whose exact character is difficult to determine. Fumes may be either organic compounds or inorganic.

Smoke is...composed largely of solid particles of carbon and droplets of tar.

Some fumes are poisonous, as those from processing ores which contain arsenic, sulphur, etc.

Beryllium...fumes (dusts) have real money value when collected. They also are poisonous.

To remove solid dust or droplet fumes, the simplest method is a water spray. A water spray is useful only on particles several microns in diameter.

A much more effective procedure is to subject the air and fume to an electrical discharge.

One of the most effective units for collecting suspended particles is the electrostatic precipitator.

The electrostatic precipitator is particularly useful when the dusts have an economic value, as in smelters and metal refineries.

The simple water spray does a partial job, involves a relatively low first cost and low operating cost. It is most useful where large dust particles are to be removed.

The direct combustion device has a definite field where fuel is cheap and organic odors (or combustible material) must be removed.

The catalytic method is quite economical in relation to fuel consumption and very effective. It completely removes combustibles, but obviously will not affect mineral dusts or non-combustible solids or fumes.

The electrostatic precipitator will remove dusts, fumes, and droplets while

Descriptors

dust
solids
carbon
arsenic
solid dust
electrostatic precipitator
direct combustion device
fume
organic compounds
tar
sulphur
water spray
smelters
catalytic method
disposal
inorganic
poisonous
Beryllium
electrical discharge
metal refineries
absorbtion

Abstract (continued)

reauiring very little power. This process is extremely effective in completely removing very small amounts of dust or fumes. It will not remove gas or vapors. This device is effective on particles which are extremely fine.

Another method of removing vapors and fumes is by absorbtion in activated charcoal.

Disease/Solid Waste
Abstracts

No. DSW-227

Author		
S. H. Jenkins		
Title		
Sewage, Trade Wastes & River Pollution		
Reference		
Reports of Prog. on Applied Chem, Vol 46, 1961 pp. 40		
Doc. No.	**Contract No.**	**Date issued**
Soc. of Chem Industry, London		

Abstract

There is growing public concern...at the polluted state of estuaries and coastal waters, especially those used for bathing or recreational purposes. ...it arises mainly from the possible potential danger to health of off-shore discharges of untreated sewage and from beach pollution by oil. A Medical Research Council Report on sewage contamination of bathing beaches (11) in England and Wales, therefore, appears at an opportune moment. It regards bacteriological standards of water quality for bathing beaches as impracticable, and criticises their use in the United States on the grounds of wide variation in standards from place to place and the absence of any critical epidemiological evidence to support them. Since pathogenic organisms isolated from coastal waters receiving sewage can arise only from infections already present in the neighbouring community, the committee responsible for the report concludes that it is better to concentrate on the risks of food poisoning than on the more remote risks of poisoning after these organisms have passed down the sewer outfall. The report admits that there are a few aesthetically revolting beaches round the coast but, these apart, the risk to health of bathing in sewage-contaminated sea water can be ignored.

Synthetic detergents-Most of the powdered detergents are sodium alkylbenzene-sulphonates with 10-14 carbon atoms in the alkyl side-chain (20).

The treatment of organic sludges by the Zimmerman process represents a new departure in sludge disposal since it aims at complete destruction of the organic matter by cooking the sludge at a high temperature under pressure in the presence of air. Organic matter is oxidised at 515°F to H_2O, N_2, CO_2, steam and ash.

In two papers of interest the possibility of worm diseases being spread by sewage sludge is considered. Digested sludge from Pretoria could suffer a 100%

Descriptors

sewage
estuaries
untreated sewage
pathogenic organisms
organic sludges
worm diseases
hookworm
chromium
nitrification
filter
distillery wastes
adsorption
dimethylamine
wastes
trade wastes
coastal waters
oil
food poisoning
Zimmerman process
Ascaris
Taenia saginata
activated sludge
toxicity
Actinomyces
mineral oil waste
clinker
catalytic oxidation
bacteriophage
pollution
health
contamination
synthetic detergents
sludge disposal
filariasis
human beef tapeworm
BOD removal
cyanides
biological oxidation
phenol
Orlon
nylon

Abstract (continued)

reduction in viable ova of Ascaris, the disease responsible for filariasis or hookworm, when stored in large heaps for 2 months, but sometimes only 85-95% inactivation resulted (34). In contradiction of previous conclusions the effect of digesting sewage sludge for 20 days at 35° was to inactivate the eggs of Taenia saginata, the human beef tapeworm (35).

Chromium-...The activated sludge process....Up to 0.5 ppm of chromium was almost completely removed; with 5 ppm, some emerged with the effluent and 50 ppm applied continuously caused only a 3% lowering of BOD removal. Nitrification was at first inhibited, but after 10 days acclimatisation it was restored regardless of the concentration. Since 18.4% of Cr was present in the activated sludge, it was concluded that reduced chromium showed hardly any toxicity in this process.

Cyanides-The biological oxidation of cyanides by applying solutions to a percolating filter inoculated with a strain of Actinomyces was examined. Up to 50 ppm of CN- could be destroyed, but it was concluded that the organisms require the absence of organic matter. Biological oxidation does not yet appear to be a practical method of treating cyanide wastes (40). Organic cyanides, however, are removed to the extent of 82-98% when mixed with sewage and acclimatised activated sludge, but it is essential to provide organic matter to maintain efficient oxidation.

Distillery wastes may be treated anaerobically with a BOD removal of 95% in 6 days, leaving an effluent which is treatable aerobically. ...mineral oil waste...can be purified with $FeCl_3$ or $FeClSO_4$ with 75-80% efficiency, leaving a slightly toxic effluent requiring a 10-20 dilution to be rendered harmless (45).

A promising method of removing phenol from carbonisation effluents is by adsorption, particularly by clinker.

In the manufacture of Orlon part of the organic matter in the waste water is dimethylamine in the solvent-recovery liquor and has been eliminated by direct and catalytic oxidation. The treatment of nylon manufacturing wastes with activated sludge has given rise to an interesting observation. When the sludge became dispersed the cells were being attacked by bacteriophage. Young sludge was resistant to attack whereas older sludge seemed to succumb more readily (50).

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Disease/Solid Waste
Abstracts

No. DSW-228

Author

W. E. Garrison, J. D. Parkhurst & C. A. Nagel

Title

Gas Recirculation-Natural, Artificial

Reference

Water Works & Wastes Eng., Feb. 1964

Doc. No.	Contract No.	Date issued
pp. 58		

Abstract

High-rate digestion is recognized by most authorities as a loading in excess of 0.15 pounds of volatile solids per day per cubic foot of digestion tank capacity.

...A digested sewage sludge containing less than 400 ppm of volatile acids in most instances may be considered adequately stabilized. In addition to volatile acids content, parameters for a digested sludge would be low odor level, good drainability, and a pH preferably about 7.0.

High-rate digestion undoubtedly occurrs in localized portions of most anaerobic tanks.

Although expressions of loading in pounds of volatile solids per cubic foot per day is not ideal, it appears to be the best available indicator to relate design to operation. The pounds of volatile solids are an indicator of the food supply to the digester and can be determined from the percent solids in the raw sludge, a reliable volumetric measurement of the flow of sludge, and good laboratory control to indicate the volatile fraction.

In the past, accepted practice recommended 30 to 60 days detention; thus the concept of eight to 10 days detention constitutes a radical change in time for sludge digestion. For a constant detention period in a given digester volume, an increase in loading of pounds of volatile solids per cubic foot per day necessitates a more concentrated sludge.

Mixing can be achieved by mechanical impeller-type units, gas mixers, or external mixing pumps. The most important factor in mixing is to bring raw sludge into intimate contact with the digesting sludge mass as quickly and thoroughly as possible. Frequent incremental feeding of raw sludge can be considered a partial substitute for adequate mixing. European practice utilizes deep digesters which taper toward the top so that all of the evolving gas passes through a relatively small surface area.

Descriptors

high-rate digestion
volatile acids
solids
mixing
anaerobic digesters
volatile solids
odor
raw sludge
grit deposits
sludge
digester
sludge digestion
toxic

Abstract (continued)

The Los Angeles County Sanitation Districts have some digesters operating without mechanical or gas mixers, but with continuous pump recirculation. Reliance is placed upon the gas production in the sludge mass to keep the contents adequately mixed. For dependable operation, artificial mixing is essential.

Maintaining maximum active volume in a digester requires minimizing grit deposits. The prime objective of grit removal at a sewage treatment plant should be to remove only that fraction of grit which will deposit or separate in a digester.

The maintenance of reasonably uniform temperatures throughout a digester is a commonly accepted requirement. This can be accomplished with external heat exchangers, by direct stream injection, by internal heating coils, or by preheating the raw sludge.

...Optimum digester operation requires the charging with a uniform and concentrated raw sludge.

Wastes toxic to the digestion system should be prohibited from entering the collection system.

Results compiled over a two-year period at the Districts' Joint Water Pollution Control Plant indicate conclusively that if the proper equipment and controls are provided, anaerobic digesters can satisfactorily stabilize primary sewage sludge at loadings up to 0.43 pounds of volatile solids per cubic foot of digester capacity per day.

Disease/Solid Waste Abstracts

No. DSW-229

Author

Yonosuke Kaibuchi

Title

Research on Composting of City Refuse and Nightsoil

Reference

J. of San. Eng. Div., SA 6, 3002, 11/61

Doc. No.	**Contract No.**	**Date issued**
pp. 101, Assoc. Amer. Soc. of Civil Engineers		

Abstract

The continuous use of chemical fertilizers alone, is causing a decrease in soil quality in many agricultural areas and a large quantity of organic matter such as manure is required to supplement these soils. A disposal process which treats human excreta and refuse in a sanitary manner and at the same time manufactures plant nutrients in an easily usable form, is aerobic composting.

"High-Rate Composting" may be described as a process in which putrescible materials in organic waste such as carbohydrates and proteins are oxidized and stabilized biologically in a matter of days, while the pathogenic organisms in these wastes are destroyed and made harmless by the heat generated in the process.

Raw waste materials are first ground and are fed continuously to a mechanical digester for stabilization. Material in the digester is stirred slowly either continuously or at short intervals. Digested material is recycled and mixed with the raw ground waste and the entire mass is kept in an aerobic and thermophilic condition. With the use of such a process and under favorable conditions, compost can be produced in a matter of days. In windrow composting that is, when ground material is piled on the ground and periodically turned, about 3 weeks are necessary for the material to obrain the same degree of decomposition. In order to distinguish it from the conventional windrow methods of composting, the process under examination will be referred to as "high-rate composting."

Composting in Windrows.-At the same time the previously described high-rate composting experiments were being made, a separate investigation of windrows composting was carried out.

Experiment 1 - The physical compostion of raw material for experiment 1 is shown in Table 26.

Aeration.-Usually temperature is regarded as the measurement required to

Descriptors

research
nightsoil
disposal
aerobic composting
carbohydrates
raw waste
garbage
thermophilic bacteria
pathogens
fertilizer
composting
fertilizers
human excreta
"high-rate composting"
proteins
windrow composting
decomposition
digester
odors
Dano digester
city refuse
manure
refuse
organic wastes
pathogenic organisms
aeration
mesophilic bacteria
humus
sludge

Abstract (continued)

know to what degree material under treatment is composted. It is very doubtful, however, that temperature is a good measurement for this purpose, because a high temperature of the material in the process of composting does not necessarily mean that the decomposition of material is proceeding well. If the material is piled up and left alone, its temperature does up. In addition, the material has the capacity to retain heat. Therefore, once its temperature rises, that high temperature will be maintained, even though the decomposition of the material is actually low. For such decomposition it is necessary to provide an ample and continuous supply of oxygen. An experiment made at Michigan State University shows that the oxygen contained in garbage in windrows decreased to 3% at a point 8 in. below the surface in 10 hr after this pile of garbage was turned over.

It is known that when material is composted in windrows, the amount of natural aeration is small and oxygen runs short rapidly, causing decomposition to be slow.

When the amount of aeration is identical with the required quantity of oxygen, the decomposition of the material by mesophilic bacteria takes place first and then high temperature caused by this decomposition provides a favorable environment for thermophilic bacteria that begins their activities in the later stage. However, some portions of the material will attain a temperature that is high enough to destroy bacteria and it is supposed that in such conditions thermophilic bacteria take some time for recovery. The most favorable conditions for composting will be produced when (1) the amount of aeration is large enough to deprive the material of the degree of heat capable of destroying bacteria, and (2) the amount of aeration is capable of keeping the material at the temperature that is favorable for the growth of thermophilic bacteria.

Digester - The decomposition of material in the digester consisted mostly of the decomposition of carbohydrates and proteins. Thermophilic bacteria played the principal role in this decomposition, which took place mostly on the 1st deck and the 2nd deck.

In the digester, the decomposition of organic matter was approximately 30% and the material turned into a good quality humus. Nevertheless, the material did not attain the temperature necessary for destroying all pathogens, specifically, 60°C.

It seems that the most influential factors in high-rate composting are the plowing and the mixing of the material. Further studies must be made on the mechanical mixing features of the composting plant.

When the end products discharged from the digester are piled up, the temperature can be maintained at 60°C which is sufficient to destroy all pathogens.

The experiments made it clear that it was impossible to prevent bad odors in the windrow composting of refuse. On the other hand, the composting operation with the digester proved to be entirely odorless.

Composting of Nightsoil with Refuse and Fertilizing Values of Compost

If the moisture of the raw material is over 60%, good compost cannot be produced. It has been proven in the experiments with the pilot plant previously

Abstract (continued)

described that by weight, the maximum quantity of nightsoil to be added to refuse in composting is only 2/5 of the amount of compostable refuse, the moisture content of which is 40%.

...If the nightsoil is anaerobically digested, its overflow liquor can be stabilized by other biological methods and thus sludge that remains is about 10% by volume of raw nightsoil. Therefore, it is possible to compost the total digested nightsoil sludge produced in Kobe with the total compostable refuse produced. Moreover, digested nightsoil sludge is not only a more valuable fertilizer, than raw nightsoil but also is easier to handle.

...The easiest way to stir and move material in the digester was to use plows, to the ends of which screw-type ribbons were fixed. Of course a rotary-kiln digester, as that of the Dano-type, will serve this purpose. Pile, stir and mix ground material in a closed structure that prevents the emission of bad odor. The Dano digester treats non-ground material and usually produces good compost. The total annual expenditure of the Kobe plant is larger than its annual returns. However, the results of the test prove that the compost is very effective as an organic fertilizer.

Sludge produced at a sewage disposal plant or a nightsoil disposal plant can be composted with refuse only when the water content of the mixture is 60% or less. Sludge alone can be composted if it is dewatered to the extent that its water content is 60% or less and it is in a granular state.

...The following may be an effective method for disposing of large quantities of nightsoil: Treat aerobically the mixture of sewage and effluent of the nightsoil digested anaerobically at a high rate and compost the dewatered sludge of the mixture alone.

Abstract (continued)

TABLE 1.—RANGE OF CONSTITUENTS IN RAW MATERIAL[a,b]

Vegetable and putrescible	Paper	Soil	Straw	Metal	Glass and Porcelain	Wood	Textile
30-70	5-30	10-40	1-5	0.1-1	1-3	1-10	0.5-2

[a] Percentage by weight

[b] The unit weight of the raw material was 400-675 lb per cu yd and the initial moisture was 50% to 55%.

TABLE 2.—(Exp. 4)

Material	Moisture, percentage	Ash, percentage	Volatile matter, percentage	Carbon, percentage	Nitrogen, percentage	C/N, percentage
Feed material	57.7	46.9	53.1	20.5	1.24	23.6
End product from the digester	37.1	61.9	38.1	21.0	1.12	18.7
End product piled in windrows after 5 days	39.1	62.4	37.6	20.9	1.10	19.0

TABLE 20

		Ash	Total organic matter	Crude fiber	Organic matters other than crude fibers
	Raw material	100	133	50.9	82.1
A	End product from digester	100	83	40.4	42.6
B	Above end product piled in windrows 5-7 days	100	71.9	31.0	40.9

TABLE 21

		Total organic matter, percentage	Crude fiber, percentage	Organic matter other than crude fiber, percentage
A	In digester	37.6	20.3	48.0
B	In windrows	13.6	23.3	3.99

Abstract (continued)

TABLE 22.—MICRO-ORGANISM DISTRIBUTION[a]

		Raw Material	Top stage	2nd stage	3rd stage	4th stage	End product	End product piled in windrows
A	Total bacteria	$1,8 \times 10^{8}$	5.4×10^{9}	9.2×10^{9}	1.7×10^{9}	3.6×10^{9}	3.5×10^{9}	1.7×10^{8}
	Glucose decomposing bacteria	$1,8 \times 10^{8}$	9.2×10^{8}	1.8×10^{9}	1.7×10^{9}	1.4×10^{8}	1.8×10^{8}	4.9×10^{7}
	Gelatin decomposing bacteria	$3,5 \times 10^{2}$	1.6×10^{5}	1.6×10^{5}	$9,2 \times 10^{3}$	[illegible]	2.4×10^{3}	$1,3 \times 10^{2}$
	Aerobic cellulose decomposing bacteria	$1,1 \times 10^{1}$	3.3×10^{1}	3.3×10^{1}	$3,3 \times 10^{1}$	$3,3 \times 10^{1}$	4.9×10^{1}	3.3×10^{1}
B	Total bacteria	$1,7 \times 10^{9}$	1.6×10^{10}	$9,2 \times 10^{9}$	$2,5 \times 10^{9}$	$1,6 \times 10^{10}$	6.4×10^{9}	$9,5 \times 10^{8}$
	Glucose decomposing bacteria	$1,7 \times 10^{9}$	$1,7 \times 10^{8}$	$1,4 \times 10^{8}$	4.5×10^{7}	$3,5 \times 10^{8}$	7.9×10^{7}	$4,9 \times 10^{7}$
	Gelatin decomposing bacteria	$9,2 \times 10^{5}$	$5,4 \times 10^{3}$	$5,4 \times 10^{5}$	1.6×10^{6}	$1,6 \times 10^{6}$	3.5×10^{5}	$1,3 \times 10^{5}$
	Aerobic cellulose decomposing bacteria	$3,3 \times 10^{2}$	3.4×10^{3}	$2,4 \times 10^{3}$	3.5×10^{3}	$1,3 \times 10^{3}$	9.2×10^{3}	$3,3 \times 10^{3}$
	Fungi	$3,2 \times 10^{5}$	2.6×10^{5}	$2,8 \times 10^{5}$	2.1×10^{5}	$3,05 \times 10^{6}$	4.1×10^{5}	9.1×10^{6}
	Coliform	$4,9 \times 10^{6}$	4.5×10^{4}	$2,2 \times 10^{5}$	$4,0 \times 10^{5}$	$1,3 \times 10^{6}$	3.3×10^{6}	3.3×10^{3}
	E. Coli.	7.9×10^{5}	$2,8 \times 10^{3}$	$2,2 \times 10^{4}$	$7,0 \times 10^{4}$	$1,7 \times 10^{5}$	$2,7 \times 10^{5}$	$9,2 \times 10^{1}$

[a] (Organisms; per gram, wet weight basis).

Notes: (A at 55°C
(B at 37°C
The fungi were obtained by Waksman's culture. (plate culture) at 27-30°C.
The numerical figures for those other than fungi were obtained by the "most probable number method."
The above data were compiled by the Osaka Hygienic Laboratory at the request of the writer.

TABLE 26.—COMPOSITION OF RAW MATERIAL[a]

Vegetable and putrescible	Paper	Soil	Straw	Metal	Porcelain	Wood	Textile	Rubber
50.6	6.4	25.2	2.1	1.0	5.2	6.3	2.5	0.7

[a] All in percentages.

Abstract (continued)

TABLE 27.—CHEMICAL ANALYSIS (Exp. 1)[a]

	Moisture	Ash	Volatile matter	Carbon	Nitrogen	C/N
Initial	49.7	49.6	50.4	28.6	0.95	29.4
5th day	40.8	52.1	47.9	26.6	1.02	26.2
7th day	39.2	55.5	44.5	24.9	0.98	25.6
9th day	32.3	58.6	41.4	23.1	1.01	22.6
12th day	23.2	58.3	41.7	23.1	0.94	24.5
14th day	24.0	62.2	37.8	21.0	0.93	22.7
17th day	19.5	63.8	36.2	20.0	0.90	22.4

[a] All in percentages.

TABLE 36.—COMPARISON OF DIGESTED NIGHTSOIL SLUDGE WITH RAW NIGHTSOIL [a,b]

Constituent	Raw nightsoil	Digested nightsoil sludge	Vacuum filtered digested nightsoil sludge (Elutriated)	Centrifuged digested nightsoil sludge (Piled up for 10 days).
Solids	2.8	6.0	20.0	40.0
Volatile solids	53.6	73.2	75.0	75.0
Nitrogen	17.1	7.3	2.2	4.0
Phosphorus (as P_2O_5)	4.6	10.0	7.7	10.0
Potash (as K_2O)	4.3	2.0	0.4	0.25
pH	8.7	7.0	7.5	7.9

[a] See values in percentages

[b] Dry basis except solids

TABLE 37.—WEIGHT OF THE PLANT HARVESTED[a]

Fertilizers used	Part	Pot 1	Pot 2	Pot 3	Average
$K_2O+P_2O_5$	Yield	5.0	4.7	4.8	4.8
	Leaves and stem	5.3	4.5	5.0	4.9
$K_2O+P_2O_5$+Compost	Yield	7.2	7.2	6.0	6.8
	Leaves and stem	8.0	8.0	5.5	7.0
$K_2O+P_2O_5$+N	Yield	6.2	5.1	10.2	7.3
	Leaves and stem	5.1	5.0	9.0	6.4
$K_2O+P_2O_5$+N+Compost	Yield	12.0	13.5	13.1	12.9
	Leaves and stem	9.6	9.5	9.3	9.5

[a] All values in grams.

Disease/Solid Waste
Abstracts

No. DSW-230

Author

Joseph W. Lenehan

Title

Air Pollution Control in Municipal

Incineration

Reference

J. of the Air Poll. Con. Assoc., Vol. 12, No. [illegible],

Doc. No. **Contract No.** **Date issued**

Sept. 1962, pp. 414

Abstract

Initially, the refuse generated on farms was fed to the livestock and used to nourish the soil and what was left was burned or thrown on the junk pile.

...Soon it was learned that landfills bred insects and disease carrying rodents.

...Incineration...eliminates the unsanitary landfill, uses the 80% combustibles to burn the remaining waste, handles the unloading of refuse trucks without littering the surrounding area, can be located close to population centers, and operates without difficulty most of the time.

...The incinerator must be close to population centers to be economically sound. The smoke nuisance then becomes doubly objectionable.

...The incinerator is a potentially large source of air pollution. ...A 500 ton per day incinerator will produce 900 to 1200 cfm of exhaust gases at 1800°F per ton and without air pollution control equipment will emit 10,000 lb of fly ash per day, which is intolerable in urban areas. The key to successful incinerator planning is the control of air pollution with special emphasis on fly ash collection.

The simplest method of fly ash control is the settling chamber. As requirements for air pollution control grow more restrictive, it can be expected that settling chambers will have a minor role in fly ash collection.

The simplest type of scrubber is the water curtain. In its application to incineration, sprays of water are directed in patterns to achieve maximum contact with the gas.

...The scrubber has the benefit of partially absorbing odors, oxides of nitrogen and sulfur dioxide.

Descriptors

air pollution
refuse
rodents
fly ash
odors
muli-cyclone collector
incineration
insects
waste
settling chamber
oxides of nitrogen
fabric collectors
landfills
disease
smoke nuisance
scrubber
sulfur dioxide
precipitators

Abstract (continued)

The muli-cyclone collector...is a common collector in general use and has been frequently applied to incinerator fly ash collection. Collection efficiencies are in the 80 to 90% range, cost is moderate, and maintenance is low.

The application of fabric collectors to incinerators is still in a priminary stage of development mainly because of the high operating temperature requirements for the filter cloth.

The increase of combustibles in refuse and the development of continuous high temperature incinerator operation indicates there is a possible field of application for fabric filters in incineration.

The use of precipitators on large power plant installations for fly ash removal is taken for granted these days. Their ability to remove fine particles with nearly 100% efficiency is well proved....

Purchase and installation costs are quite high. Operating costs are low since little current is used, and maintenance is restricted to the usual electrical service.

Precipitators have not come into use in the incinerator field because the cost is considered higher than was warranted by the requirements. The unpredictable nature of the effluents in incineration also excessively vary the electrical properties of the fly ash making precipitator operation difficult.

Abstract (continued)

COMPARATIVE DATA-AIR POLLUTION CONTROL FOR MUNICIPAL INCINERATOR

COLLECTORS	COMPARATIVE SPACE REQUIREMENTS	*COST IN $/CFM GAS TREATED (OUTLET CONDITIONS)	COLLECTION EFFICIENCY	GAS TEMPERATURE		WATER TO COLLECTOR PER 1000 CFM GAS TREATED		GAS CONDITIONING PRIOR TO TREATMENT IN COLLECTOR
				INLET OF COLLECTOR	OUTLET OF COLLECTOR	EVAPORATED	TOTAL	
Settling Chamber with Sprays	60%	$.10-.20	40-60%	1800°F	500°F	1.0 GPM	2-3 GPM	None Required
Scrubber								
Spray Type	50%	$.30-.35	75-85%	1800°F	200°F	1.7 GPM	4-8 GPM	None Required
Flooded Plate	30%	$.55-.65	90-95%	1800°F	200°F	1.7 GPM	3-5 GPM	None Required
Venturi	25%	$.35-.40	92-97%	1800°F	200°F	1.7 GPM	4-8 GPM	None Required
Cyclone								
Multi-Cyclone Spinner Vane	25%	$.22-.27	80-92%	500° to 700°F	500° to 700°F	None	None	1. Waste heat boiler cooling to 600°F 2. Evaporative spray cooling to 700°F 3. Air dilution cooling to 700°F
Cyclones to 60" dia. Tangential Inlet	30%	$.25-.30	75-90%	500° to 700°F	500° to 700°F	None	None	Same as for Multi-Cyclone
Wet Wall Cyclones	25%	$.27-.32	85-94%	600° to 1000°F	400° to 600°F	0.2-0.5 GPM	2-4 GPM	Evaporative spray cooling to 1000°F
Fabric Collector								
Glass Cloth	100%	$.75-1.00	99%	500°F	500°F	None	None	1. Evaporating spray cooling to 700°F plus air dilution cooling to 500°F 2. Waste heat boiler cooling to 600°F plus air dilution to 500°F
Electrostatic Precipitator								
Dry Precipitator	90%	$.80-1.20	95-98%	600°F	600°F	None	None	1. Evaporative spray cooling to 600°F 2. Waste heat boiler cooling to 600°F

*Collector Cost Erected

Disease/Solid Waste
Abstracts

No. DSW-231

Author

Committee on Refuse Disposal, APWA

Title

Municipal Refuse Disposal, APWA

Research Foundation Project 104

Reference

Pub. Administration Service, Chicago, 37, Ill.

Doc. No.	Contract No.	Date issued
Lib. of Cong. Cat. Card No.	61-17151	1961

Abstract

It is estimated that more than 90 million tons of refuse are produced each year in urban areas of the United States. Surveys by the American Public Works Association and the Unites States Public Health Service show that less than 50 percent of the United States cities with populations of more than 2,500 dispose of community refuse by approved sanitary and nuisance-free methods. Approximately 80 percent of the urban and rural communities with populations between 1,000 and 5,000 dispose of refuse in open dumps. Obviously, refuse is often handled with scant regard to sanitation standards, health hazards, and attendant blight in the immediate neighborhood and the entire community.

Mishandling is costlier than the use of good refuse disposal methods. The economic losses-in medical bills; fire and rodent damage; air and water pollution; use of makeshift insect sprays, traps, and poisons; exterminators fees; and depreciated property values - can be staggering. Prompt and efficient collection and disposal of refuse are essential to environmental sanitation and the establishment of preventive health measures.

Many studies and reports have been made that provide a well founded basis for remedial action on a local or area basis. It has been four decades, however, since a comprehensive text of the thoroughness, scope, and authoritativeness required for nationwide application has been published.

The objective in this manual...is to review past and present disposal practices, principally in the United States; to gather pertinent data, bearing in mind geographic and seasonal differences; describe and analyze the best current practices; broadly indicate the costs; and discuss administrative and management problems. In short, provide authoritative information for officials responsible for refuse disposal in local, state, and federal governments.

Descriptors

refuse
epidemics
garbage reduction
abandoned automobiles
"slops"
condemned foods
collection
vesicular exanthema
dead animals
special wastes
metal furniture
composting
plagues
burial
street refuse
solid wastes
rats
industrial wastes
fertilizer
"offal"
incineration
flies
sanitary landfills
demolition wastes
mineral matter
rodents
microorganisms
disease
rubbish
hazards
trichinosis
organic wastes
sewage solids
"swill"
"trash"
disposal
vermin
garbage grinding
construction waste
crockery
insects
health
mosquitoes
ashes
dust

Abstract (continued)

Data on quantities of refuse produced regionally and seasonally, heretofore unavailable on this scale, were collected in cooperation with the United States Public Health Service through on-site studies in 12 cities known to have accurate statistical records. Data on equipment were solicited from manufacturers and are included on a selective basis.

Table 3

REFUSE MATERIALS BY KIND, COMPOSITION, AND SOURCES

Kind		*Composition*	*Sources*
Refuse	Garbage	Wastes from preparation, cooking, and serving of food; market wastes; wastes from handling, storage, and sale of produce	Households, restaurants, institutions, stores, markets
	Rubbish	Combustible: paper, cartons, boxes, barrels, wood, excelsior, tree branches, yard trimmings, wood furniture, bedding, dunnage	
		Noncombustible: metals, tin cans, metal furniture, dirt, glass, crockery, minerals	
	Ashes	Residue from fires used for cooking and heating and from on-site incineration	
	Street Refuse	Sweepings, dirt, leaves, catch basin dirt, contents of litter receptacles	Streets, sidewalks, alleys, vacant lots
	Dead Animals	Cats, dogs, horses, cows	
	Abandoned Vehicles	Unwanted cars and trucks left on public property	
	Industrial Wastes	Food processing wastes, boiler house cinders, lumber scraps, metal scraps, shavings	Factories, power plants
	Demolition Wastes	Lumber, pipes, brick, masonry, and other construction materials from razed buildings and other structures	Demolition sites to be used for new buildings, renewal projects, expressways
	Construction Wastes	Scrap lumber, pipe, other construction materials	New construction, remodeling
	Special Wastes	Hazardous solids and liquids: explosives, pathological wastes, radioactive materials	Households, hotels, hospitals, institutions, stores, industry
	Sewage Treatment Residue	Solids from coarse screening and from grit chambers; septic tank sludge	Sewage treatment plants; septic tanks

Abstract (continued)

Table 8

CALORIFIC VALUE, MOISTURE, AND ASH CONTENT OF REFUSE, CHICAGO, ILLINOIS, 1956-1957

Date	*Calorific Value (Refuse) BTU/lb.* High	Low	Average	*Per Cent Moisture (Wet basis)* Garbage	Refuse	*Per Cent Ash in Refuse*
3/56	4,810	2,880	3,370	61.0	15.0	37.2
4/56	5,320	3,680	4,280	...	...	...
5/56	4,820	3,200	4,050	...	...	...
6/56	4,600	3,610	4,120	78.6	16.2	38.5
10/56	4,390	3,230	3,790	...	12.1	...
2-3/57	3,590	2,700	[illegible],310	72.3	10.4	48.0
4/57	...	...	3,890	76.4	20.8	25.6
6/57	...	...	...	69.1	18.2	38.2
Average	4,590	3,220	3,830	71.5	15.5	37.5

Table 9

PHYSICAL ANALYSES OF REFUSE BY WEIGHT AND VOLUME, CHICAGO, 1956-1958

Date	Number of Samples[1]	*Per Cent by Weight* Paper	Grass	Garbage	Metal	Glass	Ashes	*Per Cent by Volume* Paper	Grass	Garbage	Metal	Glass	Ashes	Density Lbs. per Ft.
3/56	10	50.1	*	6.4	18.5		25.0	68.4	...	3.9	18.1		9.6	15.00
4/56	8	64.0	...	7.4	13.9		14.7	80.5	...	4.4	10.7		4.4	14.38
5/56	9	57.3	11.9	5.6	14.0		11.2	79.0	4.6	2.6	10.9		2.9	15.20
6/56	6	60.7	6.5	2.5	13.6		16.7	...	...	..	...		...	13.50
10/56	6	56.0	4.5	3.5	11.9		24.1	...	...	..	...		...	12.40
2&3/57	4	49.2	...	6.1	17.5		27.2	69.3	...	2.7	17.9		10.1	14.80
4/57	1	53.3	19.7	3.2	9.3	5.9	8.6	69.4	12.4	1.7	11.5	2.5	2.5	16.33
9/57	2	42.0	23.0	3.6	7.4	5.4	18.6	58.9	20.8	1.7	9.1	3.0	6.5	....
11/57	1	59.3	3.7	2.3	5.2	6.5	23.0	73.0	5.2	0.8	9.8	1.5	9.7	....
2/58	1	57.6	...	5.7	11.6	9.3	15.8	82.0	...	1.8	10.3	2.5	3.4	7.60
2/58	1	56.3	...	1.5	7.5	6.0	28.7	81.7	...	0.8	8.5	1.8	7.2	8.11
2/58	1	70.4	...	2.6	8.0	6.9	12.1	86.7	...	1.1	7.7	2.3	2.2	8.38
4/58	3	63.7	...	1.5	8.1	5.8	20.9	82.3	...	1.0	9.0	2.4	5.3	9.11
6/58	1	54.7	34.4	0.8	6.2	3.5	0.4	71.8	22.9	0.8	2.3	2.1	0.1	12.22
Average		56.5	9.6	4.8	14.8		18.7	74.9	8.8	2.9	13.3		6.0	13.66

[1] One sample consists of one truck load of refuse (approximately three tons).

*Analysis for this category not performed; grass included with paper.

Abstract (continued)

Table 10

MONTHLY DISTRIBUTION BY WEIGHT OF ORGANIC AND INORGANIC REFUSE DISPOSED OF IN NEW YORK CITY, 1939

	Per Cent Weight								
	Organic					Inorganic			
Month	*Garbage*	*Misc.*	*Paper*	*Wood*	*Total*	*Metal*	*Glass*	*Ashes*	*Total*
January	5.7	1.0	12.4	0.3	19.4	4.3	4.0	72.3	80.6
February	9.0	1.7	12.6	0.7	24.0	6.6	4.9	64.5	76.0
March	9.7	2.1	20.6	0.3	32.7	7.4	7.3	52.6	67.3
April[1]	18.1	2.8	21.6	2.0	44.5	7.4	6.9	41.2	55.5
May[1]	26.7	3.3	23.0	3.1	56.1	7.1	6.8	30.0	43.9
June[1]	35.1	3.8	24.3	4.6	67.8	6.4	6.8	19.0	32.2
July	43.8	4.1	25.5	5.9	79.3	6.6	6.3	7.8	20.7
August	23.1	7.4	37.6	3.8	71.9	11.6	5.1	11.4	28.1
September	12.6	5.6	26.7	4.9	49.8	8.2	9.1	32.9	50.2
October	10.1	3.8	31.0	2.6	47.5	8.9	4.0	39.6	52.5
November	6.6	1.9	18.0	2.1	28.6	3.8	2.9	64.7	71.4
December	3.5	0.8	9.0	0.8	14.1	3.1	1.9	80.9	85.9

[1] No data available; by interpolation.

Table 11

MONTHLY DISTRIBUTION BY VOLUME OF ORGANIC AND INORGANIC REFUSE DISPOSED OF IN NEW YORK CITY, 1939

	Per Cent Volume								
	Organic					Inorganic			
Month	*Garbage*	*Misc.*	*Paper*	*Wood*	*Total*	*Metal*	*Glass*	*Ashes*	*Total*
January	6.0	1.3	44.9	0.4	52.6	9.9	3.1	34.4	47.4
February	9.1	2.4	41.2	1.1	53.8	13.1	3.6	29.5	46.2
March	7.7	1.8	56.1	0.1	65.7	11.1	4.4	18.8	34.3
April[1]	9.0	2.9	54.7	1.7	68.3	10.8	4.1	16.8	31.7
May[1]	10.3	4.0	53.3	3.3	70.9	10.5	3.7	14.9	29.1
June[1]	11.6	5.1	51.9	4.9	73.5	10.2	3.4	12.9	26.5
July	12.9	6.1	50.5	6.5	76.0	9.9	3.1	11.0	24.0
August	12.3	6.9	40.1	8.3	78.6	9.5	2.7	9.2	21.4
September	8.0	9.3	44.0	8.4	69.7	12.8	4.8	12.7	30.3
October	6.9	4.7	52.5	5.7	69.8	13.2	2.1	14.9	30.2
November	6.0	2.5	45.1	5.9	59.4	7.6	1.9	31.0	40.6
December	4.7	1.1	37.4	1.4	44.6	8.4	1.8	45.2	55.4

[1] No data available; by interpolation.

Abstract (continued)

TABLE 16

OPERATING COSTS FOR MUNICIPAL INCINERATORS IN SIX UNITED STATES CITIES[1]

(Per ton of refuse processed)

Philadelphia	$4.24
Washington, D. C.[2]	2.28
Detroit	4.30
Milwaukee	6.49
New York City[3]	5.55
Los Angeles	3.13

[1] Costs are for one plant in each city in 1959 except New York, where figures are for 1958 for an average for three plants.

[2] Does not include amortization costs.

[3] Cost computed on basis of tons burned (amount charged minus residue).

TABLE 18

PARAMETERS OF DESIGN FOR REFUSE FURNACES

	Type of Refuse*	Grate Loadings in Lbs. of Refuse per Hour of Operation per Square Foot of Grate Area	Volume in Cubic Feet per Ton of Refuse per 24 Hours	
			Furnace (Primary) Chamber	Combustion (Secondary) Chamber
Range of Values	M	58 to 109	8.5 to 25.0	12.1 to 28.0
	R	50 to 72	13.4 to 14.5	26.6 to 31.8
	C	54 to 98	9.9 to 13.8	17.2 to 28.3
Average Values	M	77	12.7	18.5
	R	58	13.6	29.9
	C	77	11.5	21.3

*M—Mixed refuse made up of garbage, rubbish, and non-combustibles.
R—Refuse comprised of burnable rubbish only.
C—Refuse containing combustibles only, such as garbage and burnable rubbish.

Abstract (continued)

TABLE 19

APPROXIMATE COMBUSTION CHARACTERISTICS OF VARIOUS KINDS OF MATERIALS AND AMOUNTS OF AIR NEEDED FOR COMBUSTION

Material	*High Heat Value*[1] *(B.T.U. per Lb. of MAF*[2] *Waste)*	*Air Needed for Complete Combustion (Lbs. per Lb. of MAF Waste*[3]*)*
Paper	7,900	5.9
Wood	8,400	6.3
Leaves and grass	8,600	6.5
Rags, wool	8,900	6.7
Rags, cotton	7,200	5.4
Garbage	7,300	5.5
Rubber	12,500	9.4
Suet	16,200	12.1

[1] Values are necessarily approximate, since the ultimate composition of the combustible part of the materials varies, depending upon sources. The heating value of the material as it is received is obtained by multiplying the moisture-free and ash-free B.T.U. value of the materials by 1 − (% moisture + % ash)/100. For example, garbage with a MAF value of 7,300 and containing 35 per cent moisture and 5 per cent ash or other noncombustible material will have an "as-fired" heating value of 4,380 B.T.U. per pound.

[2] MAF means moisture-free and ash-free if ash refers to total noncombustible materials.

[3] These values are also approximate and are based on 0.75 pounds of air per 1,000 B.T.U. for complete combustion. For various percentages of excess air, multiply these values by (100 plus per cent of excess air)/100. For example, if paper is burned with 100 per cent excess air (5.9) 200/100 = 11.8 pounds of air per pound of moisture-free and ash-free paper will be required.

TABLE 22

PARTICLE SIZE OF FLY ASH EMITTED FROM GANSEVOORT INCINERATOR, NEW YORK CITY

Size	*Per Cent by Weight*
Plus 120 microns	5.8
Plus 90 microns minus 120 microns	6.5
Plus 60 microns minus 90 microns	17.7
Plus 40 microns minus 60 microns	13.2
Plus 30 microns minus 40 microns	12.5
Plus 20 microns minus 30 microns	1.9
Plus 15 microns minus 20 microns	3.4
Plus 10 microns minus 15 microns	21.2
Plus 5 microns minus 10 microns	5.8
Minus 5 microns	12.0

Abstract (continued)

TABLE 23

CHEMICAL ANALYSIS OF FLY ASH EMITTED FROM GANSEVOORT INCINERATOR, NEW YORK CITY

Component	*Per Cent by Weight*
Organic	14.5
Inorganic	85.5
Silica as SiO_2	36.0
Iron as Fe_2O_3	10.0
Alumina as Al_2O_3	27.7
Calcium as CaO	8.5
Magnesia as MgO	3.4
Sulfur as SO_3	9.7
Sodium and potassium oxides	4.7
Apparent specific gravity	2.58

TABLE 32

SUMMARY OF ANALYSES AND WEIGHT CHANGES IN LABORATORY COMPOSTING OF REFUSE AT SAVANNAH, GEORGIA, 1958

(Average values based on 13 runs with 32 composting units; batch time averaged 8.8 days)

Constituent	*Per Cent of Dry Wt.*		*Signif. Diff.* ([X] *at 95%)*	*Weight (lbs.)*		*Signif. Diff.* ([X] *at 95%)*	*Per Cent Change in Weight*
	Raw Refuse[*]	*Compost*		*Initial*	*Final*		
Total wet wt.	100.0[Y]	100.0[Y]		40.47	27.31	Yes(−)	−32.5
Moisture	57.1[Y]	56.8[Y]	No	24.58	15.85	Yes(−)	−35.5
Total solids (dry wt.)	100.0	100.0		15.89	11.46	Yes(−)	−27.9
Ash (dry wt.-volatile solids)	7.8	12.4	Yes(+)	1.25	1.43	Yes(+)	+14.4
Volatile solids	92.2	87.6	Yes(−)	14.64	10.03	Yes(−)	−31.5
1. Lipids (ether soluble material)	10.1	3.3	Yes(−)	1.62	0.38	Yes(−)	−76.7
2. Crude fiber	35.9	45.8	Yes(+)	5.66	5.26	Yes(−)	− 7.0
3. Total sugar	4.9	0.0077[Z]	Yes(−)	0.80	0.0006	Yes(−)	−99.9
4. Starch	8.1	1.4	Yes(−)	1.32	0.15	Yes(−)	−88.4
5. Protein (6.25N)	8.2	11.0	Yes(+)	1.29	1.25	No	− 2.7
6. Sum: (1)-(5)	67.2	61.5	Yes(−)	10.69	7.05	Yes(−)	−34.1
7. Volatile solids−(6) (undetermined)	25.0	26.1	No	3.95	2.98	Yes(−)	−24.6
Nitrogen (N)	1.30	1.76	Yes(+)	0.207	0.202	No	− 2.7
Carbon (C)	50.0	47.7	Yes(−)	7.96	5.47	Yes(−)	−31.3
Ratio: C/N	38	27	Yes(−)	38	27	Yes(−)	

[*] As composted, after sorting and grinding.

[X]—Significant difference at 95 per cent level (t-test); — indicates decrease; + indicates increase.

[Y]—Per cent of wet (total) weight.

[Z]—Only one value (0.2%) was above minimum limit of analysis.

Abstract (continued)

TABLE 33

RELIABILITY OF TESTS TO DETERMINE DEGREE OF COMPOSTING OF GROUND, SEPARATED GARBAGE

Test	*Raw Waste*	*Finished Compost*	*Reliability*
pH	5-6	8-9	Indirectly related; reliable only after change pattern established
Chemical oxygen demand	85% reduction		Good reliability
Oxygen consumed	25% reduction		Fair reliability
Total organic (100%—% ash)	80-90%	60-70%	Reliable but requires large, finely ground sample
Transmittance	70%	10%	Indirectly related; reliable only after change pattern established
Starch	75% reduction		Dependent on degree of digestion of only one constituent

TABLE 35

ANALYSIS OF HOUSEHOLD AND COMMERCIAL RUBBISH IN THE DISTRICT OF COLUMBIA, BY SELECTED DAYS, 1956[1]

	Household Rubbish				*Commercial Rubbish*	
	May 30, 1956		*December 5, 1956*		*May 30, 1956*	
	Per Cent by Volume	*Per Cent by Weight*	*Per Cent by Volume*	*Per Cent by Weight*	*Per Cent by Volume*	*Per Cent by Weight*
Paper products	59.7	60.4	77.3	68.3	66.7	71.4
Metal, cans	19.4	13.1	9.1	10.8	14.8	11.1
Glass	11.9	16.3	7.5	11.5	11.1	12.7
Wood	6.0	8.4	1.5	4.2	3.7	3.2
Rags	1.5	.8	.8	.5	3.7	1.6
Leaves	..	..	3.0	3.5	..	..
Miscellaneous	1.5	1.0	.8	1.2	..	..

Abstract (continued)

Table 36

PHYSICAL AND CHEMICAL ANALYSES OF INCINERATOR FLY ASH, 1959

Physical		*Chemical*	
Sieve No.	*Per Cent Passing*	*Component*	*Per Cent of Total*
100	88.3	SiO_2	50.28
200	62.9	Fe_2O_3	3.16
325	55.5	B_2O_3	29.85
Ignition loss	3.96	CaO	8.23
		MgO	2.86
		Sulfur	0.80
		Other	0.86
		Ignition loss	3.96

Table 38

EQUIPMENT USED TO PROTECT EMPLOYEES AT REFUSE DISPOSAL FACILITIES

Head (including hair and ears)	Skull guard (hard hat)
Face and eyes	Hood Goggles Face shield Welding helmet
Respiratory system	Oxygen breathing apparatus Air respirator Canister and cartridge respirator Filter respirator
Hands and feet	Gloves and hand leathers Safety shoes Foot guards
Body	Chemical resistant clothing Heat resistant clothing Cold resistant clothing Water resistant clothing Radioactive resistant clothing Special purpose equipment: Life line Life ring Reflector belt

Disease/Solid Waste Abstracts

No. DSW-232

Author
Report of a WHO Expert Committee

Title
Environmental Change and Resulting
Impacts on Health

Reference
World Health Org. Tech. Rep. Series. No. 292

Doc. No. **Contract No.** **Date issued**
Geneva, 1964

Abstract

...The relationship between man and his environment has changed and is continuing to change at an increasing rate. The changes, particularly in highly developed countries of the world, are producing complex problems of public health and environmental health control in relation to increased density of population, accelerated urbanization, and continuous industrial expansion resulting from new developments in science and technology.

...In spite of the technological developments of recent decades, some two-thirds of today's world population had still to solve basic environmental health problems of a strictly microbiological nature.

Fuel additives such as lead are emitted by these engines and, while they do not as yet constitute a hazard to health, need continual study.

...The diesel engine, when properly adjusted and used, is free from many of the disadvantages of other forms of traction. There is no evidence that it causes disease.

Pollution of the air by newer synthetic chemicals seldom occurs and, when it does, is almost always accidental, since the synthetic chemicals are usually prime products which are not allowed to escape.

Occasionally, pollution of the communal air by exotic substances, such as beryllium and asbestos, has unforseen dramatic and unwelcome effects among the general population. Not only must the community be protected by constant vigilance, but such exposures as might occur either accidentally or in ignorance of their possible consequences should be studied minutely, since they may yield clues as to the fundamental mechanisms by which diseases are produced. The importance of this principle is illustrated by the modern approach to work on the effects of asbestos.

Descriptors

public health
cholera
diarrhoeal
lead
beryllium
air pollution
respiratory disease
chemical pollutants
Culex fatigans
gastro-intestinal disease
fertilizer
night soil
garbage
fly
sulfur dioxide
anaerobic digestion
groundwater
microbiological
typhoid
dissolved solids
disease
asbestos
irritant
iron
toxic
urban filariasys
research
reclaimed waste materials
refuse
disposal
rodent
chemical solid wastes
fungicides
enteric diseases
dysentery
fluorides
synthetic chemicals
asthma
allergen
pathogens
detergents
worm disease
sludge
solid wastes
rubbish
semi-solid waste
hydrochloric acid
composting
insecticides

Abstract (continued)

The epidemics of "asthma" in New Orleans and in the Tokyo-Yokohama area are clinically distinct syndromes, and are undoubtedly caused by air pollution. While the New Orleans syndrome seems to be essentially an "asthmatic" response to an irritant or allergen, the source of which has been identified, Toky-Yokohama "asthma" is a much more complex disease in which some of the changes produced are sometimes irreversible. The cause has not yet been identified, but the relevance of this clinical syndrome in the study of the etiology of chronic non-specific respiratory disease is obvious.

...Water-borne diseases take a major toll and overshadow other environmental health needs in importance; the enteric diseases, including cholera, typhoid, dysentery, the diarrhoeal diseases, and others of viral origin, are the leading causes of death and disability in areas occupied by more than two-thirds of the world population.

In many places a disproportionate amount of water is brackish, containing high amounts of dissolved solids, high fluorides or iron that have a direct effect on health.

The nature of microbiological pollutants may vary because of shifting populations and patterns of disease. However, present methods of water treatment, provided that they include an adequate disinfection process, can remove the potential pathogens so that waste treatment, while important, must generally have a lower priority than the provision of safe domestic water supplies.)

Attention has been given to chemical pollutants, especially those which are toxic or non-degradable. Pesticides have been singled out for special attention. At present, the accumulation of pesticides in water does not appear to constitute a major hazard to the health of man. As in the case of pollution by detergents, the trend is to encourage the use of more readily degradable compounds. In areas without sewer systems the water flows into open drains and has created serious problems such as radical increases in the density of the mosquito _Culex fatigans_, the vector of urban filariasis.

Unsatisfactory waste handling has caused a high incidence of worm disease and many cases of gastro-intestinal disease in rural communities.

The above circumstances indicate the need for research with a view to developing:

(a) suitable economical water treatment and re-use processes in which indigenous materials may be used and in which a minimum of skilled maintenance is required;

(b) new economical methods of sewage treatment for all sizes of communities suited to their local conditions of temperature and climate, as well as utilization of by-products, effluents, gas, and sludge as fertilizer;

(c) physical, biological and chemical methods of waste water treatment and re-use for industries;

(d) methods and processes that will reduce waste at the source and will make use of reclaimed waste materials.

Solid wastes are in many ways similar to other community wastes, for example those handled in a sewer system, and the essential difference is one of concentration

Abstract (continued)

rather than composition; all consist of a mixture of mineral and organic matter. Changing patterns in man's life and activity inevitably result in changes in the production and composition of solid wastes, notably refuse, night soil and sewage sludge.

The next most significant change is associated with the development of new industries producing disposable products for use in many different branches of industry. Also, some types of solid wastes formerly produced in small amounts by traditional industries are now found to have increased in volume and changed in nature. In the developing areas these changes accelerate the emergence of new problems and intensify existing ones. In other parts of the world the evolution of industrial technology produces new and exotic types of wastes. An increase in volume of refuse (rubbish plus garbage) per capita and a gradual change in its composition also occurs. Rubbish in modern cities contains more and more bulky material. Abandoned household fittings constitute an increasing portion of solid domestic wastes, while less and less kitchen wastes are produced because of improvements in food processing. Paper and packing materials, including a great amount of plastic and building material, constitute an increasing portion of wastes. In many countries the disposal of old cars and rubber tyres is a problem.

A large v ariety of solid and semi-solid waste products is discharged from petrochemical industries, and these are of particular importance because they constitute the base materials for so many secondary industries.

As these changes in waste production and composition take place, so their impact on health may alter. For instance, as night soil" collection and disposal is replaced by the use of modern sewer systems, many diseases associated with human waste products may become waterborne, instead of being transmitted as before by direct contact or through food. Solid industrial wastes also change in chemical composition, concentration and in volume, requiring variation in waste disposal methods. As the material becomes less and less putrescible, more is burned where sanitary landfill is impracticable; air pollution must then be avoided, as must offensive smoke or odour. There is also a need for separate treatment of certain types of industrial solid wastes by incineration.

Significant impacts on health may well be associated with these changes if the rapid expansion of growing communities overloads existing collection and disposal services, with resulting unsatisfactory removal of these wastes from the inhabited areas, or if these services break down. Water pollution - notably pollution of groundwater - and fly and rodent infestations may follow.

In industrial countries, where more and more solid wastes are burned, local problems of air pollution occur.... Harmful gases such as hydrochloric acid (from polyvinyl chloride plastics) and sulfur dioxide, may be discharged from incinerators as solid wastes come to contain more new materials. Lead batteries are burned in many places and add another dangerous constituent to the air, although this practice is prohibited in some countries. The disposal of new types of chemical solid wastes from industry must also be controlled carefully to avoid introducing new constituents into water resources and thus into drinking water. In tropical countries where certain diseases are transmitted by container-breeding mosquitoes, bulky wastes such as old cars and their tyres provide additional breeding places for the vectors of this disease.

Abstract (continued)

The best method of control consists in rapid removal of solid wastes from inhabited areas, and reduction of their volume and their potential for creating a health hazard. Mechanized collection of "night soil and its disposal by a proper method such as anaerobic digestion or composting will reduce hazards to health in communities where sewer systems are not available. Refuse should be stored and collected sufficiently frequently in standardized containers designed to minimize propagation of odours, flies and invasion by rodents.

Recent changes affecting food include the use of new chemicals and substances such as antibiotics to preserve foodstuffs and to control disease in plants and animals, defoliants to make harvesting easier, herbicides, fungicides, hormones administered to poultry and animals used for food, and insecticides of all types.

Recent evidence shows that, even in developed countries, much more salmonellosis and other disease due to food pathogens occurs than is being reported or than had been previously suspected; possibly less than 1% of such cases are reported. Epidemiological studies of food-borne illness are complicated by the fact that foods produced and processed in one country may be consumed in another. Better food hygiene and temperature control becomes increasingly necessary as the trend towards mass-cooked meals in schools, factories, institutions and homes continues.

The question of purity of waters from which shellfish are harvested should continue to receive attention. Outbreaks of infective hepatitis, alleged to have been caused by consumption of such raw foods, have stimulated fresh interest in this subject.

Some research may be necessary on other toxins; for example, it has been shown that certain strains of Aspergillus flavus and other fungi can produce toxin (aflatoxin) in groundnuts (Arachis hypogaea).

At the risk of over-simplification the following points may be given in summarizing the assessment of environmental changes and their relative impacts on health in different parts of the world today.

1. Owing to the great care with which the peaceful uses of nuclear energy have been developed in recent years and the continued surveillance which it is necessary to give to medical radiology and to the use of radioactive isotopes both in medicine and industry, the danger to mankind constituted by ionizing radiations is very limited in terms both of population at risk and of world area.

2. Air pollution, while a serious threat to susceptible individuals in the high-density urban or industrial areas where it occurs, is not, relative to other health problems, a major one affecting the whole modern world.

3. The provision of safe drinking water continues to serve high priority as a preventive measure in relation both to morbidity and mortality.

4. Solid wastes are increasing in quantity and changing in quality, but for the greater part of the world their safe collection and disposal is largely a problem of administrative willingness, of finance and of priorities: the problem of night soil", however, is an exception for which further research is required. Research should continue in developed countries into improved methods of disposal.

The exact impact on health, resulting from environmental change may be correctly assessed only by careful experimental epidemiological studies, the success of which, in turn, depends on the quality of medical statistics available. These

Abstract (continued)

studies, coupled with an assessment of the proportion of the population at risk, enable priorities to be listed, expediency often being an important factor. It is only in this way that unbalanced, unnecessary or abortive expenditure on combating health hazards may be avoided.

In developing countries changes in the environment brought about by the reclamation and settlement of arid or humid regions may create health hazards by the introduction of diseases whose vectors or intermediate hosts depend on the presentce of water for their survival and reproduction. The increase in the prevalence and intensity of bilharziasis following the establishment of irrigation farming is an example of the consequences of failure to provide adequate measures to protect public health. WHO has been active in combating this problem and has had a measure of success in defining and evaluating the factors involved in the transmission and control of the disease. Again, new semi-rural communities may be brought into contact with natural reservoirs of infection (e.g., bilharziasis and such zoonoses as sylvatic plague, tularaemia and the arboviruses) no doubt previously acquired by isolated dwellers in rural areas who made little demands on medical services. The reporting of illness and diagnosis of infection is likely to increase in these circumstances. It was also considered that industrial hygiene, with particular reference to the agricultural worker, deserved attention.

Descriptors (continued)

salmonellosis
food pathogens
research
bilharziasis
arboviruses
infective hepatitis
Aspergillus flavus
vectors
sylvatic plague
toxins
Arachis hypogaea
intermediate hosts
tularaemia

Disease/Solid Waste
Abstracts

No. DSW-233

Author

J. R. Paul & J. D. Trask

Title

Poliomyelitic Virus in Sewage

Reference

Science, Vol. 90, No. 2333, pp. 258

Doc. No.	Contract No.	Date issued
Sept. 1939		

Abstract

Within the past two years it has become increasingly apparent that poliomyelitic virus may be readily isolated from the stools of human patients during acute and convalescent stages of this disease. ...Whenever poliomyelitis occurs within a city, there is at least an opportunity for this virus to enter the local sewage system. But actually poliomyelitic virus has never been demonstrated in sewage, and there is no information as to the possible amounts which may be there, nor the length of time which this virus might survive in this medium.

...Samples of sewage were collected ...from a few sites throughout the city during the period of July 7 to 14, 1939. Particular attention was paid to one pumping station in which the sewage came not only from the hospital where poliomyelitis patients were isolated, but also from that part of the city where most of the cases had arisen. ...75 and 45 cc, respectively, were inoculated intraperitoneally into one monkey. One monkey...was inoculated intraperitoneally with 125 cc on July 14. Both these animals developed experimental poliomyelitis. After a brief febrile period both animals developed guadriplegia, and both were prostrate on the third day of their disease. Spinal cord lesions, demonstrable histologically, were found to be very extensive in both animals. It is unusual in our experience to see rhesus monkeys develop such a severe form of the experimental disease when inoculated with material from a human source, and so we have suspected that the amounts of virus in the inocula here were not small.

...Our other attempts to isolate virus from Charleston sewage were unsuccessful as a result of the premature death of the monkey from infection.

It is not evident from this work whether the presence of poliomyelitic virus in sewage is a direct or even an indirect link in the chain which leads this infectious agent from one patient to another in this disease. Our report merely calls attention to the fact that poliomyelitic virus man not only be present in urban sewage but also that it may possibly be present in appreciable quantities.

Descriptors

infectious agent	poliomyelitic virus	sewage
disease	quadriplegia	

Abstract (continued)

TABLE 1

TESTS FOR POLIOMYELITIC VIRUS IN SEWAGE SPECIMENS

Sewage specimen	Original amount	Interim between collection and inoculation	Amount of Inoculum		Monkey No.	Result
			Intraperitoneal	Subcutaneous		
(A) Pump	3.5 liters	6 and 7 days	36 cc	22 cc	1229	Abscess of abdominal wall; acute peritonitis. Killed on 4th day.
(B) Har.	0.5 liter	7 days	24 "		1231	Chronic and acute peritonitis. Died on 18th day.
(C) Pump (1)	8 liters	1 and 2 days	120 "		1227	Poliomyelitis. Killed on 10th day. Passage to monkey 1248 successful.
(2)		3 days	125 "		1232	Poliomyelitis. Died on 8th day. Passage not done.
(D) Hosp. (1)	7 "	5 "	75 "	125 "	1235	Infected abdominal wall. Died on 2nd day.
(2)		6 "	25 "	46 "	1240	Abscess of abdominal wall. Killed on 4th day.

Disease/Solid Waste
Abstracts

No. DSW-234

Author

World Health Organization

Title

Environmental Health Aspects of Metropolitan Planning and Development

Reference

Report of a WHO Expert Committee, WHO TR Ser., 1965, 297

Doc. No.	Contract No.	Date issued

Abstract

Undoubtedly, the health and sanitary aspects of urban complexes are largely known, and it might be concluded that they need no further investigation. Yet this is no so; one reason being that, in matters of this kind, cost is of controlling importance. What we must search for is not merely a method of control, but a feasible method of control; a solution, therefore, within the economic and operational reach of the people to be protected or within the financial and administrative capacity of the country concerned or, failing this, within the economic and operational capacity and willingness of the international community.

To cater for the mass of people who must be incorporated into a modern industrial economy in urban areas, municipal services will have to be provided on a heretofore unprecedented scale. The United States Municipal News in 1955 estimated that (based on U.S. conditions at that time) every 1000 new people in a metropolitan area require the following:

(a) 4.8 elementary schoolrooms and 3.6 new high-school rooms;
(b) an additional school operating budget for approximately $114.000 per year;
(c) 8.8 acres of land for schools, parks and play areas;
(d) an additional 100,000 gallons of water per day, or 36.5 million gallons per year;
(e) more streets to maintain and clean, snow to plough, garbage and refuse to collect, not to mention the cost of surfacing streets and providing for storm drainage;
(f) 1.8 new policemen;
(g) 1.5 new firemen;
(h) payroll increases for new public service employees (public works, recreation, health, tax collection);

Descriptors

See Page 9

Abstract (continued)

(i) one additional hospital bed;
(j) 1000 new library books;
(k) a fraction of a jail cell;
(l) an expenditure of approximately $65,000 to control air pollution;
(m) severage and treatment for 170 pounds of organic (BOD) water pollutants per day, or 62,060 pounds per year from 36.5 million gallons of used domestic water, or 300 new septic tank leaching systems.

The establishment and maintenance of a healthful environment, particularly in urban areas where environmental health problems are most acute, require the bringing together of the social, biological, and physical sciences concerned with the health aspects of man's relationships with his environment; it involves safeguarding water, air, food, conveyances, dwellings, and the recreational and living environment. It involves not only control of the quantity and quality of the basic necessities, but also, importantly, control of waste by-products, whether solid, liquid, or gaseous. These by-products, if uncontrolled, would leas to widespread disease.

A study of the public health problems associated with metropolitan development and urbanization, particularly in the developing nations, revelals that the more immediate problems are to be found in the environmental mental health field.

The application of available technology is often prevented by inadequate legislation, ineffective governmental co-operation, lack of finance, and lack of public understanding. Environmental health planning requires careful consideration of social, political, economic, and psychological interrelationships. Environmental health workers will therefore have to collaborate to an increasing extent with a broad spectrum of disciplines in the solution of metropolitan problems.

Often no direct cause-and-effect relationship between contamination and health can be established, and environmental health workers must extrapolate from their experience and exercise judgement in assessing the situation.

Community environmental planning must reach beyond the concept of simple disease prevention towards the long-range goal of comfort, efficiency, and the promotion of general well-being.

Pollution, the most obvious destroyer of our resources, takes many forms. In extensive areas throughout the world, land pollution by faeces and sullage water is a direct menace to health. Moreover, mine wastes, large-scale industrial dereliction, the indiscriminate dumping of garbage and refuse, erosion, sand and gravel pits, etc., are all taking a heavy toll of important land resources. Water pollution is perhaps the easiest form to recognize. Although water is a resource to be shared by industry, power, transport, agriculture, and communities, as well as individuals, far too often self-interest prevails and irreparable damage results. Air pollution is particularly severe in a limited number of places, and air must be increasingly regarded as a world resource to be conserved and utilized in perpetuity.

In connection with the conservation of our physical resources, it was the opinion of the Committee that in general pollution should be controlled at its source. Prevention is still considered to be very much more efficacious than cure.

Funds invested in basic public services, such as the maintenance of law and order, education, transport, communications, power, public health, water supply, sewerage, drainage and vector control facilities, refuse and garbage disposal, housing, etc., are called by economists "social overhead capital".

Abstract (continued)

Although both rural and urban areas suffer because of this rapid change (especially in Africa, Asia and Latin America), the main problem is urban. The physical and social symptoms are only too evident. They include building congestion and blight; overcrowding; bad housing, poor community facilities and services; mushrooming slums and squatters' settlements; inadequate and unsafe water supply; an almost complete absence of facilities for waste removal or disposal; bad siting and inadequate attention to flooding and surface drainage; social disorganization and various forms of maladjustment, juvenile delinquency, and crime; and, not least, disease and accidents.

Another point of importance is that the higher the development of a nation, the more numerous and voluminous are its waste products. In some places, wastes are accumulating to such an extent that they are a serious threat to society. Attempts should be made to find ways of starting cycles that make it possible to recuperate energy in some form or to obtain serviceable products from the waste, thus bringing "input" and "output" into balance. This may be necessary even when the recuperating process may result in short-term economic loss.

Far too often, in metropolitan planning, water supply, sewage and drainage are considered only as services to be provided after a land-use or other plan has been established. This approach is not only uneconomic but may introduce engineering problems that can be resolved only by drastic means. The Committee recommends that the provision of water supply, waste disposal and the network of lines which make up the systems of water distribution, sanitary sewerage and drainage by an integral part of the metropolitan plan, with its appropriate effect on the shape and form of urban developments.

In one large metropolitan area in the tropics, a focus of endemic cholera has maintained itself for decades; it is believed that until adequate water supply and sewerage facilities are provided this focus will continue to threaten other areas of the world with epidemics of this serious water-borne disease.

Numerous instances have been cited of the introduction of major new health hazards into a community because of the presence of sullage water, sewage and seepage water resulting from the lack of sewers for the disposal of used water. Closed sewers should be provided, to eliminate these public health hazards and to avoid pollution of the soil and of potential ground-water supplies. Industrial expansion has tremendously increased the amount of industrial waste that has to be collected and treated in order to avoid pollution of the soil and of receiving bodies of water. More care and skill are needed in dealing with the hundreds of new chemicals, many of which are considered to be potential hazards to health. The lack of sewerage and sewage-treatment facilities in many metropolitan areas of the world is a major cause of communicable diseases, including cholera, typhoid, diarrhoea, dysentery, filariasis, haemorraghic fever, infectious hepatitis, etc.

The transporting of human excreta and waste water from residential, commercial and industrial areas is successfully accomplished by piped systems or sewers. Separate sewer systems (sanitary and storm sewers) have been found to be the most practical method of disposing of local wastes both from the economic and from the health point of view. On the other hand, there may be instances where the combined collection (and possibly treatment) of waste and storm water may be considered; these instances must be fully justified with regard to both economic and health

Abstract (continued)

considerations. The separation of sanitary sewage from storm water may have an important bearing on the reduction of costs of sewage-treatment installations. If water and soil pollution is to be avoided, it is imperative that sewage lines, sewage-treatment facilities, and adequate storm drainage be provided for metropolitan areas. The degree of treatment required depends on many local factors, including dilution and the subsequent uses of receiving bodies of water.

The disposal of solid wastes (garbage and refuse) is an expensive problem of considerable public health significance. The waste solids of modern life increase in volume as development takes place, and consist not only of waste food, paper, cans, bottles, grass and brush, but also of broken furniture, rubble, etc. If not stored in an approved manner they form a harbourage for rodents and a breeding-place for flies; in addition they are unsightly, and a source of odour. They must be collected promptly and regularly and disposed of in a sanitary manner.

> "In all instances, the ultimate formula should provide the best possible sanitary environment consistent with budgetary capacity. Proper collection and disposal of refuse may cost as much as $10 (US) per capita per year. On the other hand, mishandling can be far costlier. The sum total of the attendant medical bills, fire and rodent damage, losses from air and water pollution, and the cost of makeshift use of insect sprays, traps, poisons, and exterminators' fees can be staggering" (Rogus, C.A. (1962) The Solid Waste Problem. In: Environmental engineering and metropolitan planning, Evanston, Ill., Northwestern University Press, p. 129.)

From the point of view of metropolitan planning the storage, collection, transport and disposal of solid wastes must all be considered. All forms of disposal require land, and this must be provided for short-term as well as long-term uses. Solid wastes can be used to reclaim low land, swamps, coastal areas or abandoned excavations, and this has been widely practised with a minimum of nuisance or of health hazard.

On the other hand, the indiscrimate disposal of solid wastes in open dumps, along roads, or in vacant lots is one of the most noxious forms of land and water pollution and should be strictly controlled.

The Committee wishes to draw attention to the need for organizing the transport of garbage in the most sanitary and efficient way possible (especially in tropical countries), in order to assure proper control of diseases such as typhoid, plague, dysentery, cholera, etc. The Committee is aware of the financial burden faced by municipalities in providing a well-designed service, because of the high operational cost with little or no cash compensation. Almost 70% of the total cost of garbage disposal is for transport. In large metropolitan areas the time schedule for collection and transport should be arranged in such a manner that traffic congestion and nuisance factors are kept to a minimum; this also infers the use of well-selected places for final disposal. Carefully planned collection routes, minimizing the time of haul, are recommended.

Abstract (continued)

The Committee reviewed the various methods used for the final disposal of solid wastes (incineration, composting, land fill, grinding and disposal through sewers, dumping at sea, dumping on land); while it recognizes that there are special merits in composting because of the possibility of economic use of the by-product, it hesitates to emphasize any particular system because of the transport cost factor, which is particularly important in large communities. Metropolitan authorities should therefore give serious consideration to incineration or to grinding and disposal through the sanitary sewer system. Each particular situation should be carefully studied by planners and engineers so that the best solution, both short-term and long-term, can be arrived at.

The problem of pollution from solid wastes can take several forms; gross or surface pollution, and pollution of subsoil, water and air. In reviewind these problems, it was found that they were especially important in the fringe areas of many of the metropolitan areas of the Eastern and Western Pacific regions, Aftica and Latin America, because of a shortage of basic sanitary facilities. Soil pollution due to seepage or discharge of chemicals, including oil, occurs in many metropolitan areas. A subtle form of the problem is the industrial refuse and industrial dereliction that is widespread in many developed countries. Uncontrolled excavation for gravel and sand, and spoil banks from mining operations can also be important community problems. Soil pollution from the indiscriminate use of insecticides or pesticides is a modern problem of growing importance, and the Committee strongly recommends that these substances be used judiciously.

The simplest and most dramatic effect of air pollution is the increasing number of deaths associated with the concentration of pollution during periods of temperature inversion, mortality being greatest among the old and infirm. There is also, however, an undeniable association between the well-being of patients with respiratory disease and air pollution measured in terms of certain specific pollutants.

More important, from epidemiological studies there is reason to believe that urban air pollution may be a causative factor in chronic bronchitis. There is also ample circumstantial evidence of a general deterioration in health in large urban centres where air pollution is increasing.

Effective metropolitan planning can play a vital role in the control of some of the important diseases of man. The efficient storage, collection and disposal of garbage and other solid wastes can prevent the breeding of houseflies, while the installation of sewerage and surface-water-drainage systems will reduce mosquito breeding, and well-designed dwellings will prevent the harbourage of rodents, fleas, bedbugs, cone-nosed bugs (*Triatoma*) and cockroaches. On the other hand, failure to plan for vector control in metropolitan areas can only lead to the creation of foci of infection, wastage of manpower through ill-health, and the expenditure of large amounts of money to correct such situations.

An example of this can be seen in the relationship between urbanization, mosquito breeding and the increased prevalence of bancroftian filariasis.

The movement of large numbers of persons from rural to urban areas has created a number of important problems in cities throughout the tropical and subtropical areas of the world. The problem of housing all these people is acute, but it is in the towns and their suburban sprawl that there is most often no reasonable water supply and almost certainly no sanitary system, no drainage, little,

Abstract (continued)

if any, organized system of sewage collection and disposal, and almost none for solid refuse. In many such situations, the threat of water-borne disease has been seen as one of the main reasons for ensuring clean water supplies, but the dangers, especially of insect-borne disease, that might attend inefficient disposal of water after use have scarcely been considered. Yet in some regions, and in certain large cities in particular, this threat has already become a reality, especially with regard to the rapid increase of one insect, the mosquito Culex fatigans, a vector of bancroftian filariasis. This mosquito has established itself in the urban environment, adapted itself to it, exploited it and turned its own peculiar characteristics to its own advantage. It is this insect which above all others has profited from increasing human urbanization and industrialization. It uses man-made breeding-places to such an extent that its population density is positively correlated with that of man. In particular, these breeding-places tend to be highly contaminated waters where the larvae are able to make maximum use of the organic pollution typical of an insanitary urban environment. The mosquito has the ability to shelter in houses, often in places that are difficult to reach with insecticides. It feeds on man and uses human blood for egg maturation. The increase in its density in situations where there is inadequate liquid-waste disposal and where the parasitic filarial worm exists in the human population has led to a dramatic increase in the prevalence of bancroftian filariasis in many parts of the world. For example, in India in 1953, 25 million persons were estimated to be living in areas where filariasis transmission occurred; in 1960 this figure increased to 64 million persons. In one large city in South-East Asia the filariasis rate has increased almost sevenfold in less than 20 years.

In seeking the causes for this, consideration must be given to two different sets of factors: those inherent in the processes of urbanization and industrialization and those intrinsic to the mosquito. Outstanding among the former is the increased use of water for domestic and industrial purposes. This in itself would be harmless if adequate provision were made for disposing of the waste, but under the conditions of rapid urban growth prevailing in most developing countries this is seldom the case. Urbanization and industrialization also almost inevitabley imply the use of modern insecticides against all sorts of noxious insects. This factor operates strongly in favour of an insect such as C. fatigans, resistant strains of which tend to appear rapidly, sometimes even in areas where large quantities of modern insecticides have not in fact been used.

The ultimate solution of the problem rests with the installation of adequate sewerage and drainage facilities. However, the cost of this may, at present, be beyond the means of the majority of countries in which the problem exists. Nevertheless, much can be done by the introduction of drains for the removal of surface water, by the efficient collection of excreta, and by the organization of efficient cleansing services at the local level. These points should be given the highest priority by municipal and other authorities.

The Committee recognizes that, although research is urgently needed, there is already in existence a sufficient background of scientific, technological, economic and administrative knowledge to make it possible to introduce effective environmental health programmes immediately.

Abstract (continued)

Specific research and investigational needs recognized by the Committee include the following:

(a) The investigation of metropolitan environmental resources carried out on a regional basis. Such an investigation should include the availability and quality of ground and surface waters; the capacity of the region to handle water, air and land pollution; the character, topography and extent of the land available; air resources; etc. The study should recognize the wide variety of demands on a region's resources and take this into account in making projections into the future.

(b) The further development of environmental health criteria as a guide for long-range planning. Additional information is needed regarding the physical and psychological effects of noise and vibration; the external and internal environment of housing and buildings; the value of recreation and community aesthetics; the effect of urbanization as a cause of disease, with particular reference to the mental aspects of the problem.

Since the water-carriage method was adopted, men have devised many new processes-chemical, thermal, mechanical and biological-that are destructive of the potential of such processes, in reference to body-waste removal and its safe disposal, conversion and destruction, is much needed. Even an interim solution of this problem would make it possible for the growing cities of developing countries to master their environment or keep it in check until their economy becomes viable enough to seek permanent solutions, and would be of immense value.

Of great interest to tropical regions is the control of bilharziasis in recreational bathing and in the management of irrigation areas surrounding urban complexes. Hope for a workable attack on this important infection rises and falls like the tides with each changing moon. Both biological and chemical research need to be pushed more vigorously, with an imaginative attack on water movements in relation to the population dynamics of the snail hosts of this disease.

Current research is centred on two divergent means of solid waste disposal: reclamation and destruction by fire. The concept of reclamation stretches all the way from the open dump, through the sanitary land fill (or controlled tipping), to windrow and mechanical composting with or without added sewage sludge or human body wastes. The concept of destruction by fire ranges from open burning, through controlled incineration in stationary or mobile units (incinerator ships in coastal towns, for example), to incineration as a key operation in district heating or as an adjunct to sewage treatment. The research prospect is by no means encouraging. The reclamation of fats and fertilizer bases has had it day; so has destructive distillation.

Communities with large and urgent urban renewal operations have been forced to give consent to the burning of combustible refuse. The feeding of garbage to swine has been made safer by research on the cooking of garbage and the prevention of swine exanthema, as well as the transmission of trichinosis to man and garbage-fed swine. Garbage grinding has added to the loads on sewerage systems and sewage treatment works, often without creating new or serious difficulties. In general, the outlook for important discoveries is discouraging. Of some promise

Abstract (continued)

are the advantages to be gained by the optimization of transport systems and of disposal centres in combination with transport methods and disposal devices; particular situations should be studied in order to arrive at general answers without resort to detailed computations for individual communities.

In a broader sense the systems approach has tremendous potential in dealing with the optimization of metropolitan facilities, providing, as it does, a methodology capable of dealing with the enormous range of complex variables that exists. In order to establish a framework of reference for use in the development of systems analysis for environmental health planning, recognition must be given to the essence of this approach, namely feedback, interaction, and reproducibility. The construction of a model assumes that there is an understanding of the basic system, of the forces acting upon it, their relative strength, the criteria for testing acceptability, and the factors essential to the model and those that can be eliminated.

To optimize, there must be an optimum-cost, efficiency, environmental standard or some other. How is an optimum selected? Can it be described? When should suboptimization be considered? When considering the total environmental health situation in a large metropolitan area, it is obvious that this is too large and complex a system to be readily encompassed by a single model. There are several aspects which could be considered as systems in themselves, for example: the physical environmental facilities system; the biological system; the ecological system; the psychological system; the economic system. Professional workers in environmental health now fully endorse the view that the various aspects of the urban environment are not independent but distinctly interrelated. Furthermore, there is acknowledgement, although not fully understanding, of the concept of "multiple environmental insults" to man from many sources, and of synergism. It will be necessary, therefore, for the systems analysis approach to urban planning to combine the various forces that are active; however, it is clear that the type of systems development visualized is a long-term one involving a great variety of talents and many contributors.

The development of new technologies is urgently needed to make environmental health programmes both more effective and more economical. The introduction of synthetic material for pipes and fittings in sewer and water services offers some hope for economy; new solutions are needed for the problem of on-site waste disposal, water conservation, utility tunnels and refuse disposal.

A study of the effect on health of the microtoxins (alone or in combination) discharged by industrial plants into the atmosphere, water or soil. The study should be supplemented by experimental determination of the maximum allowable concentrations of such pollutants.

Descriptors

health
septic tank
public health
environmental health field
general well-being
water pollution
"social overhead capital"
maladjustment
accidents
urban developments
cholera
dysentery
infectious hepatitis
collection routes
land fill
insecticides
respiratory disease
fleas
cockroaches
mental aspects
research
destructive distillation
"Multiple environmental insults"

cost
sewerage
contamination
sullage water
mine wastes
vector
disposal
juvenile delinquency
land-use
endemic cholera
typhoid
filariasis
excreta
incineration
grinding
pesticides
chronic bronchitis
bedbugs
Culex fatigans
bilharziasis
fertilizer
trichinosis
microtoxins

refuse
pollutants
disease prevention
faeces
land resources
waste removal
social disorganization
crime
metropolitan plan
communicable diseases
diarrhoea
haemorraghic fever
solid wastes
composting
dumping
land conservation
mosquito
cone-nosed bugs
urbanization
reclamation
transport systems
systems approach

Disease/Solid Waste
Abstracts

No. DSW- 235

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John B. Skinner

Title

Tabulating the Toxics

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Abstract

The table that follows contains up-to-date capsule data on the processing industries most common and most troublesome toxic substances.

Descriptors

acrolein
amyl alcohol
benzene
carbon disulfide
chlorine
cyanogen
ethylene oxide
hydrazine
lead
nitrobenzene
phosgene
toluene
hazards

acrylonitrill
aniline
beryllium
carbon monoxide
chromium
hydrogen cyanide
fluorine
hydrochloric acid
mercury
ozone
sulfur dioxide
trichloroethylene
industrial waste

ammonia
arsine
cadinium
carbon tetrachloride
cyanides
diborane
formaldehyde
hydrogen sulfide
nitric acid
phenol
sulfuric acid
xylene

Abstract (continued)

Toxic Substance	Usual State	Fire Hazard				Probable Safe Concentration	Principal Uses, or Processes Producing Potential Hazard	Mode of Entrance Into Body	Diagnostic Signs and Symptoms	Control				
		Explosive Limits, % Volume in Air		Flash Point, °F.	Extinguisher (See Notes)					Closed System	Ventilation	Medical Control	Body Protection	Emergency Protection
		Lower	Upper											
Acrolein	Liquid	2.8	31	<0	3	0.5 ppm.	Resins; intermediate for polyurethane and polyester resins.	Inhalation of vapor.	Extremely irritating to membranes of eyes and respiratory tract. This causes it to be its own warning agent.	●	●			
Acrylonitrile	Liquid	3.0	17	32	3	20 ppm.	Synthetic rubber; plastics; synthetic fibers (Acrilan, Dynel and Orlon); grain fumigant.	Inhalation of vapor; absorption through skin.	In order of appearance, there is flushing of face, increased salivation, irritation of eyes and nose, deepened and then shallow respiration. Nausea, vomiting, headache and diarrhea sometimes occur.	●	●	●	●	●
Ammonia	Gas	16.0	25.0		4	00 ppm.	Organic preparations; refrigeration; dye and color mfg.; sugar refining.	As a gas, through respiratory organs. Liquid irritates skin.	Irritation of respiratory passages, cough, and dyspnea, bronchitis, severe irritation of eyes, caustic action on skin.	●	●			●
Amyl alcohol	Liquid	1.2		91	3	100 ppm.	Organic synthesis; brewing; paint and rubber mfg.; lacquers, varnishes.	As vapor, through respiratory organs. Liquid is absorbed through skin.	Irritation of eyes and respiratory tract, headache and vertigo, dyspnea and cough, vomiting, diarrhea.	●	●			
Aniline	Liquid			158	2, 3	5 ppm.	Preparation of dyes, inks and pharmaceuticals; synthesis of organics in rubber and textiles.	Absorption through the skin most important. Some poisoning from inhalation of vapor.	Causes blood changes. In acute exposures, depression of the central nervous system may take place. In chronic exposures, liver and bone-marrow may be affected. (So-called "aniline tumors" are due to derivatives such as beta naphthylamine.)	●	●	●	●	●
Arsine	Gas					0.05 ppm.	Electroplating; smelting; organic synthesis.	Inhalation of gas.	Headache, weakness, vertigo and nausea. Pain in kidneys and liver. Can cause serious blood changes and liver damage.	●	●	●		●
Benzene	Liquid	1.4	7.1	12	2, 3	25 ppm.	Solvent; paint and varnish removers; organic preparations; dye and varnish mfg.; rubber industry.	Vapor through respiratory organs.	Acute intoxication—acts as depressant on central nervous system. If not fatal, complete recovery is the rule. Chronic poisoning damages blood-forming organs; symptoms are weakness, nervousness, loss of weight, bleeding from nose and gums.	●	●	●		
Beryllium	Metal, powder					0.002 mg./cu. m.	Metal alloys; ceramics; X-ray-tube windows.	Fumes or dust through respiratory tract.	Weakness, shortness of breath, and a cough, at first. Later extreme nervousness, loss of weight and increasing dyspnea.		●	●		
Bromine	Liquid			Note 1		0.1 ppm.	Mfg. of intermediates for fumigants, bromide salts and organics.	Inhalation of vapor.	Irritating to the eyes and membranes of respiratory system. Severe exposures can produce pulmonary edema.	●	●		●	●
Cadmium (and some cadmium compounds)	Solid					0.1 mg./cu. m.	All processes involving the heating of cadmium and cadmium alloys.	Inhalation of fumes.	Dryness of throat, coughing, sense of constriction in the chest, headache and nausea. Acute poisoning causes lung damage; chronic poisoning can damage kidneys, lungs and bones and cause blood changes.		●	●		
Carbon disulfide	Liquid	1.25	44	−22	1, 3	20 ppm.	Solvent; varnishes, preservatives; insecticides; rayon mfg.	Inhalation of vapor; absorption of liquid through skin.	Headache, vertigo, weakness, disturbances of sensation, digestive disturbances, irritation of skin, disturbance of vision, severe neural poisoning.	●	●			●
Carbon monoxide	Gas	12.5	74.2	No	4	100 ppm.	Not an article of commerce—caused by incomplete combustion.	As a gas through respiratory system.	Acute exposure: slow pulse, vertigo, headache, nausea, redness and suffusion of skin, dyspnea, unconsciousness, coma and death. Chronic: Headache, nausea, vomiting, anemia, palpitation, insomnia, failure of memory.		●	●		
Carbon tetrachloride	Liquid			(Non-flammable)		25 ppm.	Solvent; fire extinguishers; dry cleaning; degreasing agent; insecticides; sprays.	Through respiratory organs.	Headache, dizziness, drowsiness and lassitude. In severe cases, results in nausea, vomiting, abdominal pain and diarrhea. Secondary action involves kidneys and liver.	●	●			
Chlorine	Gas, liquid					1 ppm.	Organic synthesis; textile bleaching, water purification; chlorination.	As a gas through respiratory system.	Extremely irritating gas. Individual usually withdraws before severe gassing can take place. Irritates eyes, nose, throat. May damage lungs.	●	●			●

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Abstract (continued)

Chloroprene	Liquid					25 ppm.	Mfg. of neoprene.	Inhalation of vapor.	Toxic to animals, causing severe degeneration of the vital organs, depression of the central nervous system and low blood pressure. Certain polymers cause temporary loss of hair in humans and in animals.	●		●		
Chromium (and some chromium compounds)	Solid					0.1 mg./ cu. m.	Plating, leather tanning, dyeing; photography; manufacture of dyes, pigments, rubber goods.	Inhalation of chronic acid mists and of soluble chromate dusts. Skin irritant.	Irritation and ulceration of nose and skin. May cause dermatitis and lung cancer.		●	●	●	
Cyanides (NaCN, KCN)	Solid					5 mg./cu. m.	Electroplating and steel-hardening. Smelting of gold and silver.	Inhalation of mist or dust. Ingestion.	Asphyxiation; nasal irritation. Can be serious, fatal. Ingestion of small quantities causes dermatitis.	●	●		●	
Cyanogen,	Gas	6.6	42.6	No	4	10 ppm.	Organic synthesis. Used as poison gas in warfare.	Inhalation. Absorption through skin.	Asphyxiation. Serious, fatal. Constriction of throat, fullness and flushing of the head, vertigo, nausea, and vomiting. Unconsciousness and convulsions.	●	●		●	●
Hydrogen cyanide	Liquid	6.0	40.0	No	4	10 ppm.	Fumigants, organic synthesis.							
Diborane	Gas	2	25	Note 3	4	0.1 ppm.	Synthesis of organic boron compounds and metal borohydrides.	Inhalation of gas.	Edema, congestion and hemorrhages of lungs. Chills, cough and tightness of chest common signs.	●	●			
Ethylene oxide	Gas	3.0	80	0	4	50 ppm.	Mfg. of ethylene glycol and related compounds; nonionic detergents; acrylonitrile; ethanolamines.	Inhalation of gas.	Animal studies show irritation of eyes and respiratory tract. High concentrations apparently cause vomiting, convulsions and death. Aqueous solutions can cause skin injury.	●	●		●	
Fluorine	Gas			Note 1		0.1 ppm.	Oxidizer in rocket fuels. Mfg. of fluorides.	Inhalation of gas.	Moderate to severe pulmonary irritation occurs at concentrations above 2 ppm.	●	●	●	●	●
Formaldehyde	Gas, or in solution	7.0	73		3	5 ppm.	Organic synthesis dyestuffs rubber goods; inks; synthetic resins and lacquers.	Inhalation of gas. Irritant to skin and mucous membrane.	Irritation to lungs, eyes, nose and throat. Constant exposure to aqueous solution produces painful nail beds and fibrous areas. Severe irritating action on the skin.	●	●		●	●
Hydrazine	Liquid	4.7	100	126		1 ppm.	Jet and rocket fuels; corrosion inhibitor; scavenger for oxygen; salts used in soft and aluminum soldering.	Inhalation of vapor. Absorbed through the skin.	Highly irritating. Highly corrosive to skin. Symptoms may be delayed. Central nervous system involvement, vomiting, blood-pressure drop. May cause permanent corneal opacity.	●	●		●	●
Hydrochloric acid	Liquid					5 ppm.	Organic synthesis; dyestuffs; chlorides; ore reduction; food processing.	Inhalation of gas. Irritant to skin and mucous membrane.	Violent coughing, dyspnea, bronchitis, destruction of teeth, contraction of throat, coma. Caustic action on skin.	●	●			●
Hydrogen sulfide	Gas	4.3	45		Stop flow of gas	20 ppm.	Purification of hydrochloric and sulfuric acids; precipitating of metal sulfides. May form when HCl is used for chemical cleaning.	Inhalation of gas.	Irritating to eyes and respiratory tract. At high concentrations, asphyxiation may occur due to interference with oxygen transport and use in the body.	●	●			●
Lead and lead compounds	Metal				1, 2, 3	0.2 mg./ cu. m.	Chemical apparatus; storage batteries; lead pigments; solder; alloys, mining, smelting and reclaiming.	As fumes or dust through the respiratory organs and digestive tract.	Weakness, pallor, headache, metallic taste in mouth and foul breath, lack of appetite, lead line on gums and presence of lead in urine.		●	●		
Mercury and mercury compounds	Liquid metallic element					0.1 mg./ cu. m. (elemental) 0.01 mg./ cu. m. (organics)	Mercury salts; thermometers; vapor lamps; mercury amalgams, and fungicides.	As vapor and dust through respiratory organs. As liquid through the skin.	Chronic mercury poisoning usually causes nervous disorders such as restlessness, irritability, fear, depression, lack of concentration.	●	●	●	●	

Abstract (continued)

Toxic Substance	Usual State	Fire Hazard				Probable Safe Concentration	Principal Uses, or Processes Producing Potential Hazard	Mode of Entrance Into Body	Diagnostic Signs and Symptoms	Control				
		Explosive Limits, % Volume in Air Lower	Explosive Limits, % Volume in Air Upper	Flash Point, °F.	Extinguisher (See Notes)					Closed System	Ventilation	Medical Control	Body Protection	Emergency Protection
Nitric acid and oxides of nitrogen	Liquid, gases			Notes 1 & 2		Nitrogen dioxide, 5 ppm.	Manufacture of explosives and nitrocellulose, in photo engraving, metal etching, pickling and welding.	As a gas through respiratory system, and direct action on the skin.	Symptoms usually delayed. Headache, dizziness, cough, palpitation of the heart; sometimes restlessness, inability to sleep, loss of weight, constipation, and ulcers of the mucous membranes.	●	●		●	●
Nitrobenzene	Liquid	1.8 @ 200 F.		190	2, 4	1 ppm.	Mfg. of aniline; ingredient of metal and shoe polishes; raw material for mfg. of benzidene, quinoline, azobenzene.	Absorption through skin. Inhalation of vapor.	Severe poison. May effect the nervous system causing fatigue, vertigo, headache, vomiting, altered pulse, respiration and skin temperature change. May also affect the blood, liver and spleen. If large areas of the body contact the liquid, almost immediate death may result.	●	●	●	●	●
Ozone	Gas					0.1 ppm.	Oxidizing agent; for bleaching waxes, oils, textiles.	Inhalation of gas.	Lung irritation. Irritant to all mucous membranes, may cause pulmonary edema. Serious, fatal.	●	●			
Phenol	Solid			175	4	5 ppm.	Phenolic resins; epoxy resins; nylon; weed killers; germicides; pharmaceuticals.	Absorption through skin. Inhalation of vapor.	Contact of appreciable areas of the body for more than a minute can result in cyanosis, muscular weakness, tremors, convulsions, collapse and death. Acute vapor exposures may have similar effects. Severe dermatitis may occur from contact with dilute solutions. Chronic poisoning from vapor inhalation probably does not occur.	●	●	●	●	●
Phosgene	Gas					1.0 ppm.	Organic synthesis, metallurgy; glass manufacture Chlorinating agent	Inhalation of gas.	Dryness or burning sensation in throat, numbness, pain in chest, vomiting, bronchitis, and possible dyspnea. Can cause serious or fatal lung damage.	●	●			●
Sulfur dioxide	Gas					5 ppm.	Refrigeration units; gas often encountered by smelters, foundry workers, bleachers, cellulose workers, petroleum refiners	As a gas through the respiratory organs.	Very irritating to eyes, nose, throat and lungs so that individual usually withdraws from exposed atmosphere. Chronic exposure produces catarrh, disturbances of sense of smell or taste, and fatigue.	●	●			●
[illegible]	[illegible]			No	[illegible]	[illegible]	Chemical fertilizers, petroleum refining, explosives, leather industry; rubber reclaiming.	Inhalation of mist. Skin irritant	Irritant and corrosive to all mucous surfaces, causing [illegible] of upper respiratory tract and [illegible] lung damage. [illegible] enamel of teeth. Extreme corrosive action on skin.		●		●	
Toluene	Liquid	1.4	6.7	No	2, 3	200 ppm.	Organic preparations, benzoic acid, lacquer, dyes, perfumes, explosives, solvent	Inhalation of vapor.	Fatigue, weakness, confusion, and tingling of the skin. Gastric disturbances (users of alcohol specially sensitive). Slight dermatitis.	●	●			
Trichloroethylene	Liquid			No		100 ppm.	Degreasing of metal; [illegible] solvent for rubber, dyes, oils, fats, waxes, tar, resins	Inhalation of vapor.	Narcosis, possible damage to nervous system. Irritation of mucous membranes, dizziness, severe headache, fatigue.	●	●	●		●
Xylene	Liquid	1.0	7.0	No	2, 3	200 ppm.	Organic preparations; solvent for lacquer, varnishes and rubber cement.	Inhalation of vapor.	Anesthesia, irritation, slight blood changes. Narcotic effect. Fatigue, weakness, confusion, and prickling or creeping sensations of the skin. Usually transitory.	●	●			

Code Numbers for Extinguishing Agents

1. Water. (Where water can be used on a flammable-liquid fire, it is usually best applied through a spray or fog-nozzle.)
2. Foam.
3. Carbon dioxide, or dry-chemical extinguishers.
4. Carbon dioxide, dry chemical and water spray. (With gas fires, the best procedure is to use water to keep the surroundings cool until the leak can be shut off.)
5. Approved dry compound for metal fires.

Footnotes

Note #1 Fluorine, bromine, and strong sulfuric or nitric acid may cause spontaneous ignition when in contact with organic materials such as sawdust, excelsior, paper and cotton waste.

Note #2 Nitrous fumes are noncombustible. However, nitrous oxide and nitrogen peroxide will support combustion.

Note #3 Diborane may explode if mixed rapidly with air. Mixtures of 2-25% will detonate if sparked.

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Disease/Solid Waste Abstracts

No. DSW- 236

Author

Title

Sludge Treatment Plant at Sheffield

Reference

The Engineer, May 31, 1963, pp. 997

Doc. No. **Contract No.** **Date issued**

Abstract

One of the world's largest sewage sludge dewatering plants employing filter presses has recently been completed at the City of Sheffield's Blackburn Meadows Sewage Works and is now in full commission. This new installation of thirty-six presses produces 30 tons per hour of sludge cake containint 55% to 65% moisture.

The plant supersedes 20 acres of open-air drying beds and 40 acres of sludge lagoons which occupy the only available land adjacent to the sewage works and which have become inadequate to cope with the 350,000 tons of liquid sludge produced annually.

The new pressing plant occupies about 2 acres. It has cost £620,000 and its completion marks the end of the first phase of a reconstruction programme which also includes new screening and grit separation plant and new primary settlement tanks to replace tanks now forty to eighty years old. The Blackburn Meadows Works serves a population of 500,000 and the dry weather flow of 26 m.g.d. includes about 12 m.g.d. industrial wastes, much of it from the steel industry.

The liquid sludge dewatered in this installation is the combined total production of primary and activated sludge, without prior digestion.

Descriptors

sewage sludge
screening
grit separation
industrial wastes
sludge
treatment

Disease/Solid Waste
Abstracts

No. DSW- 237

Author

Title

Report Urges Federal Experiments in
Waste Control

Reference

Engineering News-Record, April 7, 1966

Doc. No.	Contract No.	Date issued
pp. 72-73		

Abstract

The definition of pollution as a "resource out of place" planted in an obscure passage in a 250-page report on waste management and control by the National Academy of Sciences, promises to hold a key to future federal thinking about environmental pollution and its control.

The report, by an NAS national research council committee on pollution under the noted scientist Athelstan Spilhaus, of the University of Minnesota, was in response to a demand from the White House's Federal Council on Science and Technology for a scientific base on which future federal policy might be built.

"The substances that we consider undesirable pollutants under some circumstances may be very valuable materials under others," the committee said. And conversely, there is no more "away" where wastes can be thrown. "One person's trash basket is another's living space, says the report.

As a first step in an integrated program of waste management, the committee recommended starting from scratch, in a "new city somewhere, with the construction of a full-scale experimental waste management system emvodying"the newest and best principles of recycling, reusing and recovering residues."

The establishment of such a testing ground for new concepts in the control and reuse of wastes is a recommendation almost certain to be taken seriously by federal planners. It is, infact, among the easier steps advocated by the NAS panel of scientists. All it takes is money, while other recommendations being made by the panel involve:

Re-examination of the legal structure underlying waste management efforts.

New organizational structures, with the federal government serving as a catalyst and "problem sheds" with common air, water or land

Descriptors

pollution
recycling
research
environmental pollution
reusing
waste management
recovering residues

Abstract (continued)

pollution problems organizing to deal with pollutants in a systematized way.

New regional organization and political institutions capable of transcending state and local boundaries.

The report characterized the nation's pollution problem as "desperate... because many of the effects of pollution on any environment may be irreversive, or, at least, may take generations to correct even if we start now."

By 1980, it cites as an example, sewage and other water-borne wastes will be sufficient to consume, in dry weather, all the oxygen in all 22 of the nation's river systems.

Each community, says the report, must set its own tolerances for "necessary and acceptable" amounts of each pollutant-tailor-made to the purposes for which each environment segment is to be used-industrial, recreational, etc.

At the same time, the federal powers to control pollution ought to be expanded, it says, and incentives to encourage pollution control should be explored.

"The right amount of pollution must be planned with criteria set somewhere between the ideal of complete cleanliness and the havoc of uncontrolled filth," says the report.

It urges the establishment of a Presidential Commission on Environmental Protection, a data and testing center to evaluate waste problems and management programs, and an accelerated program of research in both waste management systems and the questions of legislative precedent, equity and simplified access to the courts to insure a future base on which comprehensive national programs can be build.

Disease/Solid Waste
Abstracts

No. DSW-238

Author

Title

Consuming Problem - Feed pollution

problem to cattle, meat packers told

Reference

Engineering News-Record, April 7, 1966

Doc. No.	Contract No.	Date issued
PP. 149-150		

Abstract

One of the biggest headaches for the meat-packing industry is disposal of paunch manure, the undigested food - grasses and grains - that appear in the first (of four) stomachs of a slaughtered sheep, calf or steer.

Paunch manure is not only resistant to ordinary sewage treatment processes, but it clogs up treatment plants. Because of its 60% moisture content, it is extremely difficult to burn. Its smell is so odious that the cost of trucking it far enough away from civilization makes sanitary landfill disposal uneconomical (ENR 11/12/64 p. 59).

An average steer has 60 lb of this in its stomach. The 140 million steers slaughtered annually in the U.S. produce about 4.2 million tons of paunch manure. The contributions of 7.6 million calves and 15 million sheep and lambs must be added to this to get the complete paunch manure picture.

The easiest way of getting rid of paunch manure is to dump it in a nearby river. Omaha's 19 meat-packing companies dropped 250 tons of paunch manure a day into the Missouri until federal water pollution control officials said they would have to stop.

Struthers Wells Corp., Warren, Pa., manufacturers, formed a subsidiary, Farm Materials Process, Inc., to investigate more efficient ways of disposing of paunch manure. The investigators conclusion: Feed paunch manure to cattle.

Analysis of paunch manure showed that on a dry basis it was composed of 16% protein, 3% fat and 69% carbohydrate.

Fresh from a slaughtered steer, paunch manure contains digestive juices and billions of micro-organisms that normally inhabit the digestive systems of ruminant animals. After paunch namure is exposed to the air for a few hours, the digestive juices and the bacteria produce an offensive odor that makes the material unpalatable to cattle and swine.

Descriptors

paunch manure
sanitary landfill disposal
micro-organisms
bacteria
waste
food

Abstract (continued)

Farm Materials designed a heated-air sterilizing process that removes the moisture and bacteria from paunch manure and prevents production of offensive smells. The result is a product that can be fed to cattle. A burdensome waste becomes a profitable product.

The company experimented at Dakota City, Neb., with cattle, first with four head and presently with 850 head, and found that the animals not only eat the processed paunch manure, but gain weight on it. The company says that its product costs much less than regular cattle feed.

Disease/Solid Waste
Abstracts

No. DSW-239

Author

Charles A. Walker, Walter Zabban

Title

Disposal of Plating Room Wastes

VI. Treatment of Plating Room Waste

Reference Solutions with Ozone

Plating, Vol. 40, No. 7, pp 777, July 1953

Doc. No. Contract No. Date issued

Abstract

This is the second report of A.E.S. Research Project No. 10 on the removal of cyanide ions from waste plating solutions by reaction with an oxidizing agent. The first paper was concerned with the oxidation of cyanide by either chlorine or a hypochlorite reagent. The oxidizing agent used in the present investigations was ozone, a gas whose oxidation potential is second only to that of fluorine. It is formed in nature whenever a lightning discharge passes through the air, and it can be produced in the laboratory by passing dry air or oxygen between two plates electrically charged (several thousand volts) from a source of alternating current.

Ozone is now used in water purification, oxidation of plant wastes, removal of iron, bleaching of sulfate and sulfite pulps, organic reactions and as a catalyst for some oxidation processes. It has also been used recently, with some success, in the removal of cyanides by oxidation.

The purpose of this investigation was to study the mechanism and the extent of the oxidation of free and metallo-complex cyanides by ozone and to determine its possible application in the treatment of cyanide waste solutions from electroplating operations.

Other findings were that the oxidation of the cyanide ion beyond the cyanate stage was inefficient and appreciable quantities of ozone escaped unreacted from the solution, and that a pH between 10 and 12 favored the efficiency of the process. The following materials of construction were advised for ozonation of cyanide waste solutions: plastics, wood, aluminum, copper, stainless steel or black iron coated with an asphalt-type coating. It was advised that air from the treatment plant should be vented from the building to prevent deterioration of such materials as rubber insulation and other equipment parts.

According to Thorp (6) a concentration of I ppm by weight of ozone containing

Descriptors

cyanide
ozone
headaches
plant wastes
oxidation
throat irritation
cyanide waste solutions
electro-plating
toxicity

Abstract (continued)

oxides of nitrogen produces headaches and throat irritation, while pure oxone does not, even on prolonged exposure. According to Watson (7) there is no measurable difference on toxicity of ozone produced from oxygen or air and nitrogen oxides do not have a direct effect on the toxicity of ozone. The pungent odor of pure ozone can be detected at concentrations of about 0.05 ppm.

Unlike chlorine or hypochlorites, ozone does not leave any toxic products in the treated solutions. Its disadvantage relative to the hypochlorite ion is that it does not oxidize the cyanide ion beyond the cyanate stage in the contact time allowed.

Ozone could be used for the treatment of relatively large volumes of solutions containing less than about 5 ppm of cyanide (CN). The resulting solution would contain less than 10 ppm of cyanate (CNO) which is not considered to be a toxic concentration.

Oxidation of the free and complex cyanide ions by ozone results in the formation of free cyanates, insoluble metallic cyanates and hydroxes. This reaction is very rapid.

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(6) C. E. Thorp, News Ed (Am. Chem. Soc.) 19, 686-688 (1941); C. A. 35, 5987 (1941).
(7) R. Watson, Ind. Eng. Chem. 36, 559-561 (1944).

Disease/Solid Waste
Abstracts

No. DSW-240

Author

J. D. Watt and D. J. Thorne

Title

Composition & Pozzolanic Properties of

Pulverised Fuel Ashes. I. Comp of Fly Ashes

Reference

J. Appl. Chem., 15, Dec. 1965 pp. 585

Doc. No. Contract No. Date issued

Abstract

Most of the coal used in modern power stations in this country at present is fired as pulverised fuel, that is, it is first finely ground and then injected into the boiler furnace in a stream of air sufficient for the combustion of the carbonaceous matter. The particles of coal burn away as they pass through the furnace and those which remain are carried through the boiler and are ultimately collected as a fine cement-like powder commonly known as "fly ash" or "pulverised fuel ash" (p.f.a.). This is a waste product for which as yet few commercial uses have been developed and it is a constant problem to find a way of disposing of it economically without creating a nuisance. Usually the ash is dumped wherever a convenient site can be found but the cost of disposal in this way is not negligible and, since the output in this country is now 7 million tons a year and is likely to increase steadily in the future, more and more effort is being devoted to finding uses for the material which will at least partly offset the disposal costs.

Fly ash has already found application in several kinds of construction work which seem to offer the possibility of taking up large quantities of the material, e.g. soil stabilisation, grouting, construction of embankments, and as a component of concrete mixes for a number of purposes. The full development of these uses is limited partly by the lack of sufficient data to support the use of the ash in the various proposed applications, partly by the natural conservatism of the user and partly-probably the most important-by the inherent variability of the material arising from the many kinds of coal being burnt and of the conditions of operations of the boiler. Very little can be done at present to reduce this variability and it remains a very serious obstacle to the utilisation of the material. Its effects

Descriptors

waste
disposal
pozzolan
fuel ashes
soil stabilisation
composition
fly ashes
concrete mixes
properties

Abstract (continued)

in practice are made even more serious by the fact that it has not been possible so far to give an effective specification by which samples unsuitable for a particular application could be rejected; this, in turn, is because no clearly-defined relationships have been found between the behavior of an ash in these applications and its physical and chemical properties. In particular, although a number of the proposed uses for the ash depend on the fact that it is a pozzolan - that is, without being itself a cement it has the property of setting hard in the presence of lime and water by reacting with them to form cementitious calcium silicates of low solubility - very little is known of what physical and chemical factors in the ash determine its activity in this respect. Accordingly, the principal purpose of the work reported in the present papers has been to identify these factors and to find a quantitative expression for their influence, in the belief that this knowledge is essential to the full exploitation of the ash.

Abstract (continued)

Table I

Chemical analyses of fly ashes

Source of fly ash	SiO_2, %	Al_2O_3, %	Fe_2O_3, %	CaO, %	MgO, %	Na_2O, %	K_2O, %	TiO_2, %	Mn_3O_4, %	SO_3, %	P_2O_5, %	C, %	H_2O, %	Total, %	Water solubles, %
Carmarthen Bay	41·4	23·9	12·8	2·8	1·8	0·8	3·7	0·7	0·1	0·7	0·3	10·0	0·2	99·9	1·8
Castle Donington	45·9	24·4	12·3	3·0	2·8	1·0	3·2	0·9	0·1	0·9	0·4	4·1	0·1	99·6	1·8
Cliffquay	43·4	25·8	13·8	3·2	2·2	0·6	3·0	1·0	0·1	1·2	0·3	8·7	0·3	99·8	3·0
Croydon 'B'	42·8	20·1	9·9	2·4	1·4	0·8	3·6	0·8	0·1	0·9	0·3	11·7	0·3	100·0	2·0
Dunston (1)	47·7	28·6	8·3	2·1	1·8	0·4	2·6	1·1	0·1	1·4	0·2	3·1	0·6	98·2	3·0
Dunston (2)	50·7	34·1	6·4	1·7	1·7	0·3	1·6	1·2	trace	0·6	0·2	2·0	ND	100·7	1·7
Ferrybridge (1)	46·7	27·0	9·5	2·4	1·6	1·8	4·2	0·9	trace	1·2	0·2	1·3	0·3	99·9	3·3
Ferrybridge (2)	47·4	27·3	10·3	2·1	2·0	1·7	4·0	0·9	0·1	1·6	0·2	0·9	ND	99·0	4·1
Hams Hall	48·0	28·0	8·1	2·4	1·9	1·0	3·1	1·0	0·1	1·3	0·6	0·6	0·2	99·8	2·7
Rye House	43·6	24·6	11·3	7·7	2·9	0·7	2·2	1·0	0·2	1·2	0·6	2·4	0·1	98·5	4·0
Skelton Grange (1)	47·3	26·7	11·9	3·4	1·9	0·9	3·8	0·8	0·1	1·0	0·2	2·1	0·1	100·1	2·8
Skelton Grange (2)	46·5	26·6	12·0	2·7	1·7	1·2	3·0	0·9	0·1	1·1	0·4	2·3	ND	99·3	2·6
Stella South	46·1	27·5	11·9	3·7	2·4	0·2	2·2	1·0	0·1	2·1	trace	0·8	0·3	99·6	4·7
Uskmouth	44·2	26·5	8·6	1·8	1·8	0·6	3·8	0·9	0·1	0·8	0·5	8·9	0·2	99·8	3·3
Tolerance	0·7	0·3	0·5	0·2	0·2	0·1	0·1	0·1	<0·005	0·2	<0·06	0·2	0·1	—	—

Table V

Mineralogical analyses of fly ashes

Fly ash	Quartz, %	Mullite, %	Haematite, %	Magnetite, %	Carbon,* %	Glass,** %
Dunston (1)	4·5	11	2·7	1·4	3·1	77
Dunston (2)	3·8	11	1·9	1·2	2·0	80
Ferrybridge (1)	2·8	6·5	1·8	1·9	1·5	86
Ferrybridge (2)	2·2	6·5	1·1	0·8	0·9	88
Hams Hall	3·5	10	1·6	1·2	0·6	83
Rye House	8·5	14	2·1	2·5	2·4	71
Skelton Grange (1)	4·1	10	2·4	2·6	2·1	79

* Determined chemically ** By difference

Disease/Solid Waste Abstracts

No. DSW-241

Author

Title

Treatment of Acid Wastes & Waters

Reference

Acid-Mine-Drainage Problems, Anthracite

Doc. No.	Contract No.	Date issued
Region, Pa. Bul. 508, pp. 60 Bureau of Mines		1951

Abstract

The two fundamentals of rising the pH and the time available for reaction are basic to the choice of a liming material for acid-waste treatment, but there are other factors. One very important factor is the disposal of sludge. The sludge problem may be so acute where cheap land area for lagooning is not available that the dewatering and disposal of sludge outweigh all other considerations; this is one of the reasons why acid-waste-treatment processes cannot be standardized but must be tailor-made to fit the occasion.

Every acid-disposal problem utilizing lime or limestone is concerned with three basic considerations: The pH range over which the treatment is to take place, the minimum time available for the reaction between the lime or limestone and acid, and the disposal of products formed, of which sludge is of primary importance in the anthracite-mine-water problem.

If tests indicate that it is feasible to treat a given acid mine water to attain the final pH required and the time factor is not prohibitive, the selection of a suitable alkaline agent will depend on the availability and cost of both the alkaline agent and the facilities necessary to provide satisfactory disposal of the sludge.

The principal factor that threatens to curtail the life of the anthractic industry, reduce production, and affect the economic structure of the people and the businesses dependent on anthracitic for their livelihood is inundation of anthractic mines.

Acid mine water from anthractic mines, although classed an an industrial waste, is not to be construed as being an economic loss to the industry. The factor of economic damage by pollution of the receiving bodies of water confronts the industry in developing the pollution-abatement program of the Commonwealth

Descriptors

acid-waste
disposal
sludge
lagooning
acid mine water
industrial waste
self-purification
treatment
pollution
H_2SO_4

Abstract (continued)

of Pennsylvania

Although the pH of Hetch Hetchy natural water is 5.6, an interesting and serious problem arose in 1934 by the appearance of crenothrix, a type of iron bacteria. These bacteria have been found growing in the ground water that seeps into the Coast Range, tunnels, This seepage water, having a high mineral content and containing the crenothrix organism, has seeded the Hetch Hetchy water flowing through the tunnels and carried the infection into several lines conveying the water. The bacteria are not harmful to health but form a slimy growth in an equeduct, retard the flow of water, and impart an objectionable taste and otherwise affect the quality of the water.

A solution of 1 percent H_2SO_4 will corrode concrete substantially and noticeably within 1 to 2 months, but the acid load in the mine-water discharges from the anthracite mines corresponds to an acid solution of only 0.02 percent strength when based on free-acid load or 0.05 percent when based on free-acid load or 0.05 percent when based on total-acid load. The experience in the anthracite region has shown that the damage caused by such weak solutions is negligible.

It must be borne in mind that abandoned and not active mines are the principal offenders for uncontrolled mine drainage.

Experience shows that acid waters counteract the self-purification capacity of the receiving bodies of water into which the acid waters are discharged.

Every acid-disposal problem is concerned with three basic considerations: The pH range over which the treatment is to take place, the minimum time available for the reaction between the treating reagent and the acid, and the disposal of products formed, of which sludge is of primary importance in the anthracite-mine-water problem.

Disease/Solid Waste
Abstracts

No. DSW-242

Author

James L. Kelch & A. Kenneth Graham

Title

Electrometric System for Continuous

Control of Reduction of Hexavalent

Reference Chromium in Plant Wastes

Plating, May 1949, Vol. 36, No. 1 pp. 1028

Doc. No. Contract No. Date issued

Abstract

The increasing public consciousness of the need for stream-pollution control creates many new and varied problems for manufacturere who use public streams in which to discharge plant wastes. The effluents from metal-finishing plants must ordinarily be treated to remove excess acidity or alkalinity, heavy metals, cyanides, and hexavalent chromium. A practical potentiometric method for continuous control of the reduction of hexavalent chromium to trivalent chromium with ferrous sulfate (copperas) in the presence of sulfuric acid is described in this paper.

1. Continuous reduction of hexavalent chromium to trivalent chromium in plant-waste effluents by means of ferrous sulfate in acid solution is practicable and controllable.

2. The electrode system and controlling devices described here supply means for continuous control of the addition of reductant and acid to a flowing waste.

3. Ferrous sulfate in concentrations up to 12-16 oz/gal stabilized with sulfuric acid to a pH of 2.0 will reduce hexavalent chromium efficiently, provided enough free sulfuric acid or equivalent is present to insure a final solution pH of 2.5 or lower.

4. The potential of a platinum-calomel electrode system at which complete reduction of chromic acid in various concentrations may be assured is between 490 and 500 millivolts.

Descriptors

hexavalent chromium
reduction
plant wastes

Disease/Solid Waste
Abstracts

No. DSW- 243

Author

Title

Dilution

Reference

Plating, May 1949 Vol. 36, No. 1

Doc. No.	Contract No.	Date issued

Abstract

Probably the simplest method for disposal of cyanide wastes is to dump them into the nearest stream. If the stream is of sufficient volume, then the wastes may be so diluted as to be not particularly objectionable. Cyanide wastes, as already discussed, are toxic to aquatic life even in concentrations of 0.2 ppm or less over a period of time, so that in general a stream will not give sufficient dilution to render the wastes immediately nontoxic.

At first thought, the idea of allowing hydrogen cyanide to escape to the atmosphere would not seem tenable in view of the poisonous character of cyanides. Yet this procedure has been used by small manufacturing plants, as well as by very large ones, and to our knowledge there have been no accidents resulting from such practice. While the simple cyanides, including hydrogen cyanide, are exceedingly rapid poisons, yet there must be a certain concentration in the body of a living organism before toxic effects are noted and even more to be fatal. Cyanides are not cumulative poisons but are changed by the body processes to other materials which are much less toxic and which pass out with other waste products.

Krause (539) states that when acid wastes are available, cyanide wastes can best be treated by mixing the two wastes in an airing basin followed by aeration for half an hour (this time hardly seems adequate; heating the solution might decrease the time required to this extent). Wise (560) says that cyanide wastes acidified to pH 3.0 and exposed for 48 hours in ponds two feed deep were reduced in cyanide content from 100 ppm to 5 ppm CN. Oeming (646), Strell (328), Meinck (451), and Gilbert (631) all indicate that acidification followed by aeration has been a satisfactory method of treatment.

...the chemical reaction between cyanide solutions and acid gases is the same as with sulfuric acid.

Descriptors

hydrogen cyanide
acid wastes
sulfuric acid
copper cyanide
cyanates
disposal
sewer
accidents
ponds
shallow ponds
sludge
chlorine
chromic acid
sewage
poisons
aeration
cyanide plating wastes
dump
hypochlorites
wastes

Abstract (continued)

Use of Simple Ponding. Cyanide wastes left in shallow ponds are found to lose their cyanide content. If the waste is neutral or slightly acid, the loss will occur with reasonable rapidity, whereas if strongly alkaline, as is the case with cyanide plating wastes (in the absence of acid wastes being mixed in), the process will be very slow. An economic disadvantage of such a ponding process is that rather large areas of land must be available if any large amount of solution is to be handled. Operational disadvantages are the risk of poisoning animals or humans through direct access to the ponds or by seepage of cyanides through the ground to streams or underground sources of water supply (81,539).

Cotton (624) stated that copper cyanide solutions boiled with milk of lime (calcium hydroxide) decompose into formates and ammonia leaving a residue of sodium formate, copper carbonate, calcium carbonate, etc. This process is stated by him to be used by Delco-Remy to dispose of pots of cyanide heat treating salts which have gone bad. The salts are placed in a well-ventilated tank of hot water, heated by high-pressure steam, excess milk of lime is added, and the mixture boiled until evolution of ammonia ceases. The resulting sludge is carted to a dump.

Because cyanates are only about 1/1000 as toxic as cyanides, a waste containing 100 ppm cyanide would become practically nontoxic if the cyanide were all changed to cyanate. In neutral or acid solution cyanates decompose to carbon dioxide and ammonia. If sodium cyanate solution is boiled there is considerable conversion to carbonate. While the cyanates are not particularly poisonous, the tendency now on the part of pollution control authorities is to require destruction of the cyanates also.

The use of chlorine to treat cyanide wastes in basic solution is coming into wide use in the United States. Its success is due to the completeness of the reaction, the availability of chlorine, and the availability of suitable feeding equipment made possible by the wide use of chlorine for treating water supplies, and the availability of engineering "know-how" of engineering companies and consultants in the use of chlorination.

Chlorine added to a basic solution of cyanide rapidly oxidizes the cyanide to cyanate.

...chlorine is about as toxic to fish as is cyanide....

Hypochlorites and bleaching powder (an impure hypochlorite) are commonly employed as sources of chlorine and are therefore applicable for the oxidation of cyanide solutions.

Krause (539) stated that since chlorine gas should not be allowed to escape into the open (it can be seen from Table I of this report that the toxic limit for chlorine in the atmosphere is 1 ppm as compared to 20 ppm for cyanide) it is better to use hypochlorites, chloride of lime, or similar substances. However, by proper design and operation the escape of chlorine can be prevented.

Early interest in the electrolysis of cyanide solutions arose in connection with the processing of gold and silver ores where it was hoped that gold and silver could be plated out and cyanide simultaneously recovered from the cyanide milling solutions. While it was, of course, possible to plate out the metals, the cyanide was not recovered but was destroyed.

The addition of ferrous salts such as ferrous sulfate or ferrous chloride to cyanide solutions results in the formation of various ferrocyanides, soluble and

Abstract (continued)

nonsoluble, depending upon the particular composition of the solution. The ferrocyanides are relatively nontoxic; in fact, ferrous sulfate orally administered followed by an alkaline carbonate is used as an antidote for cyanide poisoning. It may be noted that, aside from any question as to the efficacy of iron compound formation in reducing toxicity, the large volume of sludge produced and the strong color of many ferro- and ferricyanides are objectionable in many cases.

We have been informed, through private communication, that the treatment most commonly used in England for the disposal of mixed plating wastes is the use of ferrous sulfate followed by lime. Two tanks are used; one for carrying out treatment with ferrous sulfate and one for subsequent liming. The contents of both tanks are usually agitated with air. The method is considered satisfactory in England for cyanide wastes, chromic acid wastes, and acid wastes generally where the resultant clear effluent is run off to the sewer or the nearest stream.

In designing a waste treatment plant one must know the volume of the waste liquor and its chemical characteristics as well as the chemical characteristics acceptable in the treated effluent before adopting a specific method of treatment. There are of course other factors to be considered also, such as location of plant, existing facilities, availability of stream, acid wastes, etc.

Dobson (684) gave the following ranges of cyanide content for various types of waste.

Plating rinse water	1	to	25	ppm
Dumped plating baths	10	to	100,000	ppm
Heat-treating quench waters	50	to	100	ppm
Coke-oven-gas scrubbing water	150	to	300	ppm
Mine tailing rinses	5	to	25	ppm

...it would appear from our review of the literature that treatment of cyanide plating wastes with sulfuric acid followed by aeration, and treatment with chlorine in alkaline solution are probably equally satisfactory and applicable to most cases.

The effect of cyanide upon the operation of sewage treatment plants has also been investigated. The permissible cyanide content of sewage seems to be much higher than of streams. Perhaps as much as 3 ppm CN can be tolerated in sewage and the amount in the waste may be higher depending upon the dilution ratio.

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Abstract (References continued)

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Abstract (continued)

TABLE I. MAXIMUM PERMISSIBLE CONCENTRATION OF ATMOSPHERIC CONTAMINANTS*

Contaminant	Conc. ppm	Contaminant	Conc. ppm
Acetone	1000	Acrolein	1
Aliphatic acetates	500	Benzene	75
Ammonia	100	Bromine	1
Carbon Dioxide	5000	Carbon Disulfide	20
Carbon Monoxide	100	Carbon Tetrachloride	50
Ether	500	Chlorine	1
Ethylene Dichloride	100	Formaldehyde	10
Methyl Alcohol	200	Hydrochloric Acid	10
Perchlorethylene	100	HYDROGEN CYANIDE	20
Petroleum vapors	500	Hydrofluoric acid	3
Toluene	200	Hydrogen sulfide	20
Trichlorethylene	100	Nitrogen oxides	25
Turpentine	200	Phosgene	1
Xylene	100	Sulfur Dioxide	10

TABLE V. WASTE ANALYSES REPORTED IN VARIOUS REFERENCES

Data	Reference No.								
	681	403	403	403	403	628	684	683	683
Gal/day	15,000	......	......	......	......	400,000	50,000	......	......
pH	9.4	2.7	6.2	3.0	1.8–3.2	......	7.7	7.95	7.5
CN, ppm	129	1.1	0.8	12	0.0–22.4	0.1	2	20	6.8
Carbonate, pp.m $CaCO_3$	220	......	......	......	......	117	......	335	315
Bicarbonate, ppm $CaCO_3$	332	......	......	......	......	......	......	360	376
Cu, ppm,	......	7.1	2.0	32	0.2–34	0.5	3	......	......
Zn, ppm	......	6.8	2.1	2.3	......	......	......	......	......
Cd, ppm	......	......	......	......	......	......	10	......	......
Fe, ppm	2.25	......	......	......	0.0–80	......	......	......	......
Cr, total, ppm	......	4.1	18.1	87	87–643	2.0	100	27.7	53.1
Cr, hexavalent, ppm	......	3.5	16.6	76	75–636	......	......	27.7	53.1
Ni, ppm	......	0.1	0.14	2	trace–6.4	0.3	......	......	......
SO_4, ppm	......	215	65	271	84 –769	44.0	......	......	......
Cl, ppm	......	......	......	......	......	15.0	......	......	......

Disease/Solid Waste
Abstracts

No. DSW- 244

Author

Title

Plating Plant Plays Off One Waste on Another

Reference

Chemical Engineering, June 11, 1962

Doc. No.	**Contract No.**	**Date issued**
Vol. 69, Number 12, p. 98		

Abstract

Novel process setup lessens cost of treating chrome-plating wastes, by utilizing sulfur dioxide in flue gas. Added dividend: the system cuts air pollution

The Ternstedt Div of General Motors Corp has gone one step farther than usual with the idea of efficient waste treatment. At its Elyria, Ohio, plant, Ternstedt uses one waste stream as the agent for treating another one.

This plant produces chrome-plated parts. Accordingly, one of its liquid waste streams contains hexavalent chromium, as chromic acid Normally this pollutant would be removed by treating the waste stream with purchased reducing agents, to convert the chromium to its trivalent form and thereby precipitate it.

But the Elyria facility's power house burns soft coal, thus introducing sulfur dioxide--a first-class reducing agent for chromic acid--into its flue gas By routing part of this gas to a scrubber where it contacts the liquid waste, the plant carries out a low-cost technique for avoiding water pollution from chrome plating, while also lessening air pollution This system has operated for about three years.

Specifics--The raw liquid waste, containing an average of 900-1,000 ppm of hexavalent chromium totals about 85,000 gal./day This material is pumped to a 75,000-gal. tank that contains a mixture of the raw stream and recycle liquid that has already been partially treated in the scrubber.

Meanwhile, gas from the bottom of each of the plant's three boiler stacks passes to the base of the scrubber, where it enters at 300-4-- F. and ascends. The amount thus drawn off is about 10% of the total flue-gas output.

The scrubber is a tower, roughly 6 ft. dia. x 21 ft. high; its construction incorporates an acid-resistant glass fiber. Part of the liquid stream enters near

Descriptors

waste
chrome-plating wastes
air pollution
waste treatment
hexavalent chromium
pollutant
precipitate
sulfur dioxide
reducing agent
solids
sludge bed

Abstract (Continued)

the top of the tower, and part near the midsection; in both cases, spray nozzles direct the material downward.

Main purpose of the lower spray is to cool the gas so that a maximum amount of it will dissolve and react with the liquid in the upper-spray section.

Results--Plant engineers have found that a single pass through the scrubber reduces the hexavalent-chromium concentration by 44-196 ppm., depending on such factors as inlet temperatures, ambient temperature, and concentration of chromium waste. Accordingly the over-all treatment includes a number of passes through the scrubber, followed by final reduction using sodium bisulfate.

The slurry of trivalent chromium flows to a settling tank. From here, the solids go to a sludge bed for drying. The liquid passes through a sampling device, then goes to the sewer.f As a graphic monitoring of the system, the water sample (after chemical analysis) feeds to an aquarium where it provides an environment for goldfish

The company figures a savings of about $1,500/mo in the cost of purchased sulfur dioxide. formerly used for the reduction operation. Over-all cost of the operation is now about 25% of what it was previously.

A similar unit is being built by Ternstedt at Syracuse, N.Y.

Disease/Solid Waste
Abstracts

No. DSW-245

Author

A. C. Hyde

Title

Chemical Plant Waste Treatment by Ten Methods

Reference

J. Water Poll. Con. Fed., Nov, 1965, , Vol. 37,

Doc. No. Contract No. Date issued

No. 11, pp. 1486

Abstract

The Belle Works is a chemical plant making more than 30 products, the major ones being ammonia, urea, nylon intermediates, ethylene glycol, methylamines, and methacrylates.

At the close of World War II, the plant undertook an organized pollution abatement program. From 1945 to the present, more than 90 percent of its summertime BOD load has been eliminated.

In a pollution abatement program, it is desirable to put control first. It is here that we can usually do the most good for the fewest dollars. The figure of 40,000 lb (18,200 kg) shown in Table I is conservative. Experience has shown us that when the plant is out of control, the daily pollution load easily can increase by more than 40,000 lb/day (18.200 kg/day). Good housekeeping and maintenance to prevent leaks and educate operators on the effects of careless and accidental loss of materials are stressed. In addition, there is a highly developed monitoring program.

The next category in Table I is process modification. The entire plant was surveyed to find where a waste might be reduced or eliminated at the source.

...A vapor-phase catalytic oxidation process developed at Belle Works and reported.... Organic wastes in a concentration range of 0.5 to 1.0 percent are completely destroyed at 575°C.

Organic acid wastes of about three- to five-percent concentration are sprayed into the top of a thermal decomposition unit vessel by means of a distributor. Three gas burners also at the top maintain a temperature of 800°C. During the downward flow, complete decomposition takes place.

...A liquid waste incinerator was built. Whereever possible processes were operated or additional equipment added to concentrate waste streams to at least 50 percent organic content. At this concentration they can be incinerated successfully

Descriptors

chemical plant waste
nylon intermediates
methacrylates
organic wastes
incinerator
activated sludge
sludges
centrifuge
industrial waste
ammonia
ethylene glycol
pollution
thermal decomposition unit
anaerobic digestion pond
aerobic
leachings
disposal
urea
methylamines
catalytic oxidation
acid wastes
fly-ash
dry solids
filtration
sanitary wastes

Abstract (continued)

without auxiliary fuel.

Some wastes of 0.2 to 5.0 percent organic concentration are accumulated during the low-flow summer months in two 2.5-mil gal (9.5-mil 1) mild steel storage tanks. These are discharged under state supervision into winter flood waters. The rate of discharge is keyed to the oxygen demand of the wastes and to the river flow. A rigid program of daily surveillance and analysis of the river below the plant is carried on throughout the discharge period. Analytical results are reported to the state daily. The impounding program has been in effect for more than 10 years and throughout this period there has been no evidence that the winter discharge has created any river problems.

The anaerobic digestion pond shown in the aerial photograph originally was built for fly-ash disposal. The pond has a surface area of 7 acres (2.8 ha) and a water depth of 15 ft (4.5 m). Seventy feed of fly-ash fill forms the bottom. When it was demonstrated 10 years ago that organics could be decomposed satisfactorily in the pond, its use for fly-ash fill was discontinued.

Operating experience in the summer of 1964 is of particular interest because of the addition of all of the waste activated sludge from the aerobic treatment plant as well as the normal feed of miscellaneous organic waste materials. The Purdue studies indicated that this could be done. So far there has been no undue odor or other operating problem. The activated sludge amounts to 6,000 lb/day (2,700 kg/day) on a dry solids basis. A number of sludges, such as filter cakes saturated with organic materials, are stored in this pit so that leachings will flow through the porous wall into the pond where they receive treatment.

By 1958 it was apparent that no further schemes such as those previously outlined could be devised. The reason for this was that the remaining waste sources were relatively large in number, large in volume, and dilute in concentration. It was apparent that they all could be collected in one system and treated biologically.

During the experimental program, filtration of the waste activated sludge by techniques developed at the Sanitary District of Chicago was attempted. Filtration was successful, but expansion to the full-scale plant would have been excessively expensive, both in operating cost and the number of new filters required. However, a centrifuge (Nozljector, manufactured by The Sharples Corp., Philadelphia, Pa.) was found to operate satisfactorily. Selection between the two processes was dependent on selection of a final method of disposal of the concentrated sludge. The filter cake contained 20 percent solids and the centrifuge concentrate 5 percent. Incineration and digestion in the anaerobic pond were the possibilities for final disposal. Currently, the pond is being used, and if this is successful over a long period the lower concentration will affect only transportation costs. Should incineration be required ultimately, concentration is more critical because of the increased cost of auxiliary fuel.

The system now collects and treats 40 percent of our sanitary wastes along with industrial waste in the activated sludge plant. Construction now under way will result in 100-percent collection and treatment.

The river is considered one of our treatment devices, in the selection of

Abstract (continued)

which waste materials will make up that 30,000 lb (13,600 kg).

The cost of operating the program outlined exceeds $1,500,000 a year. This cost has to be borne by the products manufactured at the plant.

TABLE I. Components of 5-Day BOD Reduction at Belle Works

Treatment Device	BOD Reduction (lb/day)
Control	10,000
Process modifications	79,000
Catalytic oxidation	26,000
Thermal decomposition	27,000
Incineration	84,000
Impoundment	38,000
Anaerobic pond	11,000
Aerobic treatment plant	23,000
Sanitary waste treatment	1,000
River assimilative capacity allocation	21,000
Total	350,000

Domestic/Solid Waste
Abstracts

No. DCW-246

Author

Edmund B. Besselievre

Title

Industrial Waste Treatment

Reference

McGraw-Hill Book Co., Inc. New York,

Doc. No. Contract No. Date issued

First Edition, 1952

Abstract

TABLE 11-2. POPULATION EQUIVALENTS OF VARIOUS INDUSTRIAL WASTES

Type of waste	Unit	Liquid volume of waste, gal per unit	BOD (5 days)		Suspended solids		Grease, lb per unit	Population equivalent per unit
			Lb per unit	Ppm	Lb per unit	Ppm		
Air-conditioning wash*	100 cu ft water	750	0.85		0.60		0.19	8
Cannery:								
Apricots (peeled) (lye)	1 ton	2,511.5	7.93					76
Apricots (no lye)	1 ton	2,511.5	4.16		5.41			40
Asparagus (no trim)	1 ton	6,337.5	3.9		1.6			38
Asparagus (trim macerated)	1 ton	7,650.0	73.0		76.0		4.4	700
Asparagus†	Case of No. 2 cans	70.0	100.0		30.0			0.35
Apricots†	Case of No. 2 cans	89.0	1,020.0					4.1
Cherries (dyed)†	1 ton	3,037.5	17.2		4.5			165
Beets†	Case of No. 2 cans	37.0	2,600.0		1,540.0			4.8
Beets, red‡				7,000				
Corn‡				625				
Corn (cream style)†	Case of No. 2 cans	25.0	620.0		300.0			0.75
Corn (whole kernel)†	Case of No. 2 cans	25.0	2,000.0		1,250.0			2.5
Corn products*	1 ton corn	12,000.0	19.5		30.0			186.0
Figs*	1 ton	1,327.5	2.44		0.98			23.0
Beans:								
Green‡				159				
Green†	Case of No. 2 cans	35.0	200.0		60.0			0.35
Lima‡	Case of No. 2 cans			189				
Lima†	Case of No. 2 cans	250.0	190.0		420.0			2.4
Grapefruit sections†	Case of No. 2 cans	56.0	1,850.0		270.0			4.8
Olives*	1 ton	5,925.5	222.0		4.34		9.1	2,130.0
Peas‡				1,490				
Peas†	Case of No. 2 cans	25.0	1,700.0		400			2.1
Peas (shelled)*	100 cu ft waste	750.0	8.75					84.0
Peaches (macerated)*	1 ton		60.0		54.0			580.0
Peaches*	1 ton	2,610.0	29.2		13.0			280.0
Peaches and pears* (with trim)	1 ton	1,417.5	17.2		15.0			145.0
Peaches and pears† (with trim)	Case of No. 2 cans	65.0	1,340.0					4.4
Peach waste*	1 ton fruit	2,685.0	56.8		13.4			550.0

Descriptors

Abstract (continued)

Table 11-2. (continued)

Peaches and pears:*								
Strained waste	1 ton fruit	2,115.0	43.8	....	13.4	....	....	420.0
After 10-mesh screen	1 ton fruit	2,115.0	35.0	....	11.1	....	....	340.0
Pears (macerated)*	1 ton fruit	....	60.0	....	54.0	....	....	580.0
Pear waste:								
With trim*	1 ton fruit	1,312.5	52.4	....	72.9	....	....	500.0
After ⅛-in. screen	1 ton fruit	1,312.5	24.7	....	13.1	....	....	240.0
Pork and beans†	Case of No. 2 cans	35.0	925.0	....	225.0	....	....	1.6
Pumpkin†	Case of No. 2½ cans	25.0	6,400.0	....	1,850.0	....	....	8.0
Squash‡	....	....	....	10,800				
Tomatoes‡	....	....	....	848				
Tomatoes, solid pack* (waste cycloned)	1 ton tomatoes	227.25	8.42	....	2.88	....	....	82.0
Tomato catchup:								
Through 40-mesh screen*	1 ton tomatoes	1,402.5	7.70	....	2.96	....	....	74.0
No skin or pulp	....	450.0	25.0	....	27.9	....	....	240.0
Tomatoes*	1 ton tomatoes	3,607.5	29.7	....	8.1	....	....	290.0
Tomatoes† (whole)	Case of No. 2 cans	7.5	4,000.0	....	250.0	....	....	3.5
Tomato products†	Case of No. 2 cans	70.0	1,000.0	....	2,000.0	....	....	3.5
Spinach†	Case of No. 2 cans	160.0	615.0	....	....	....	....	4.9
Spinach (no trim)*	1 ton	4,950.0	22.2	....	18.9	....	0.8	210.0
Spinach (macerated)*	1 ton	....	70.0	....	114.0	....	....	670.0
Spinach*	1 ton	8,100.0	49.4	....	6.1	....	....	470.0
Sauerkraut†	Case of No. 2 cans	3.0	6,300.0	....	630.0	....	....	1.0
Succotash†	Case of No. 2 cans	125.0	525.0	....	250.0	....	....	33.0
Sweet potatoes*	1 ton	3,525.0	8.7	....	178.0	....	1.0	84.0
Milk products:								
General creamery*	1,000 gal milk	11,000.0	101.0	....	50.0	....	9.7	970.0
General dairy†	100 lb milk intake	340.0	570.0	....	....	....	....	10.0
General creamery†	1,000 gal milk	1,470.0	107.0	....	....	....	13.3	960.0
Milk processing*	1,000 gal milk	928.0	318.0	....	....	....	....	3,030.0
Receiving station†	100 lb milk intake	175.0	500.0	....	....	....	....	4.0
Receiving station‡	....	....	....	600				
Receiving stations§	1,000 lb raw milk	180.0	500.0	....	....	....	....	4.0
Bottling†	100 lb milk intake	250.0	....	....	....	....	....	6.0
Bottling‡	....	....	....	500				
Bottling§	1,000 lb raw milk	250.0	....	....	....	....	....	6.0
Dry milk†	100 lb milk intake	150.0	480.0	....	....	....	....	3.6
Dry milk§	1,000 lb raw milk	150.0	480.0	....	....	....	....	6.0
General dairy§	1,000 lb raw milk	340.0	570.0	....	540.0	....	....	10.0

Abstract (continued)

TABLE 12-11. APPROXIMATE QUANTITY AND CHARACTER OF WASTES FROM VARIOUS STEPS IN VEGETABLE TANNING OF HEAVY LEATHER

Wastes	Volume per day, gal per 100 lb of hides	Total solids, ppm	Suspended solids, ppm	BOD (5 days), ppm	Total solids, %	BOD, %
Soaks*	80	12,000	1,200	600	17	5
Limes*	40	27,000	10,000	2,400	19	10
Warm water*	50	10,500	3,500	1,000	9	5
Dehairing	25	2,500	1,500	400	1	1
Hair washing	40	2,000	1,200	20	1	1
Fleshing	35	3,500	2,600	800	2	3
Wash wheel	200	1,600	450	700	6	15
Float box	30	300	150	25	0	0
Green stock	210	400	100	3	1	0
Spent tan*	50	27,000	1,500	10,000	23	52
Bleaches*	40	30,000	1,200	2,000	21	8

* Denotes intermittent discharges. Others are continuous. Figures demonstrate that the intermittent discharges, which constitute only about one-third of the total liquid volume, contain almost 90 per cent of the total solids and 80 per cent of the BOD of the combined wastes.

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TABLE 12-13. TYPICAL ANALYSES OF PULP- AND PAPER-MILL WASTES

Waste from	Waste volume, gal per ton of product	BOD, ppm	Suspended solids, ppm
Pulp mill:			
Groundwood	5,000	645	1,720
Soda	85,000	110	
Sulfate (kraft)	64,000	123	
Sulfite	60,000	443	
Miscellaneous paper:			
No bleach	39,000	19	452
With bleach	47,000	24	604
Paperboard	14,000	121	660
Strawboard	26,000	965	1,760
Deinking of used paper	84,000	300	

Abstract (continued)

TABLE 12-15. RECOMMENDATIONS BY THE WATER COMMISSION OF CONNECTICUT FOR TREATMENT OF TEXTILE WASTES

Type of waste	Process producing	Volume, gpd	BOD, ppm	Treatment of waste	BOD reduction expected, %
Cotton thread	Lime, scour bleaching, kier boiling, machine vat dyeing	40,000	550	Precipitation with copperas and lime	60
Finishing piece goods (cotton)	Bleaching, kier boiling, dyeing, and printing	274,000	605	Segregation of print-wash, coagulation by copperas and lime, and aeration of effluent	65
Elastic webbings and brake linings	Kier boiling, dyeing, and impregnation of linings	60,000	422	Screening, coagulation with copperas and lime, and aeration	60
Silk manufacture	Degumming, bleaching, dyeing, and printing	1,200,000	460	Cracking of gum suds, incineration of print wastes, coagulation with ferric sulfate	65
Cotton finishing	Bleaching, kier boiling, printing, and dyeing	80,000	540	Coagulation of wastes by copperas and lime and aeration	65
Cotton and rayon finishing	Bleaching, soap boiling, sizing, and dyeing	10,000	390	Collection of concentrated wastes, coagulation by copperas and lime, and aeration	60
Finishing cotton cloth	Alkali and peroxide boil, mercerizing, printing, dyeing, and finishing	438,000	478	Storage in open-air lagoons for a week, coagulation with ferric sulfate and lime, incineration of print wastes	65
Rayon goods	Bleaching, dyeing, sizing, and finishing	125,000	1,920	Storage in tanks, coagulation with ferric sulfate and lime	68
Woolen cloths	Wool scouring, weaving, dyeing, and finishing	120,000	936	Cracking with acid, coagulation with ferric sulfate and lime	75

TABLE 12-16. BEET-SUGAR WASTES*

	Type of waste			
	Flume water	Process water	Lime drainage	Steffens waste
Character of wastes	High suspended solids, vegetation, dissolved organic matter	Low suspended solids, high BOD, high dissolved solids, and colloids	$CaCO_3$ slurry, some dissolved solids	Very high dissolved solids, very high BOD, low suspended solids
Composition of wastes	Dirt, sand, weeds, pieces of beets, beet tops	Sugar, dirt, sand, beet slices	$CaCO_3$, sugar	Sugars, potash, nitrogen, organic matter
Methods of treatment	Screened, grit removed, and settled; then sent to sewer	Coagulated with lime, sent to sedimentation chambers, effluent to sewer, sludge to ponds	Lime cake diluted to slurry and then pumped to ponding area	Treated to produce fertilizer and monosodium glutamate
Remarks........	Lime can be used for treating if water is to be reused	Resulting sludge from above method does not need preconditioning for vacuum filtration	....	At present the raw materials of the Steffens process (molasses) can be sold for more than the additional sugar produced from this process

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 9.

Abstract (continued)

TABLE 12-17. CANNERY WASTES*

	Items canned†					
	Beans, wax	Corn	Peas	Spinach	Cherries	Pears
Composition of wastes:						
Waste volume, (gal per case)	26	25	25	20	40	51
Suspended solids, ppm	60	980	2,800	3,500	20	2[illegible]0
BOD, ppm	240	3,000	2,400	6,000	750	450
pH	7.6	6.5	7.0	7.0	6.2	
Character of wastes	Organic, suspended, and soluble; dirt and grit					
Method of treatment	Combined wastes are screened, the liquid is chemically treated by bath or continuous processes, lime is added, then iron sulfate or chloride, alum or zinc chloride is added. Then to coagulation tank, settling tank, with liquid discharged, and sludge to beds. Combined wastes may be sent to lagoons without pretreatment, but they require sodium nitrate treatment to prevent odors					
Remarks	All literature advocates use of lime, alone or with another chemical, in chemical treatment of all canning wastes. This treatment is quicker, antiseptic, and easier to control than biological treatment. In citrus canning, lime is used to reduce corrosive action of wastes on equipment					

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 10.

† These examples indicate range of compositions of canning wastes.

TABLE 12-18. CHEMICAL-PLANT WASTES*

	Type of process		
	DDT manufacture	Ethyl acetate manufacture	Phosphate fertilizer manufacture
Composition of waste	Sulfuric acid	Sulfuric acid	SiO_2, CaF_2, H_2SiF_6
Character of waste	Highly acidic solutions from production and processing; inorganic, very corrosive	Same as DDT, no processing waste	Inorganic, atmospheric pollution, gases and fine dust
Methods of treatment	Acid solutions are stored and neutralized with lime. Effluent is sent to sewer, and sludge is ponded	Acid solution neutralized with lime. Can be handled in same way as DDT	Gases and dust treated with CaO and heated to produce CaF_2
Remarks	Neutralization with lime found to be more economical than recovery of sulfuric acid		Still in experimental stage; would produce a valuable by-product

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 11.

Abstract (continued)

TABLE 12-19. COAL-MINE DRAINAGE*

	Type of waste	
	Mine drainage (abandoned and working)	Processing ("breaker water")
Composition of wastes	Total solids . . . 5,000-70,000 ppm Acidity . . . . . . 0-50,000 SO_4 . . . . 1,000-50,000 Iron . . . . 0-13,000 Calcium . . . . . . 100-800 Magnesium . . . 0-50 pH 1.2-7.0	Depending on the amount of processing, the waste water may be as acidic as mine drainage, greater in volume, and higher in total solids
Methods of treatment	1. Neutralization of drainage with lime 2. Chemical processes for recovery of valuable by-products 3. Dilution of drainage 4. Completely closing the mine (abandoned) 5. Sealing abandoned sections of working mines 6. Diversion of surface waters from entry into mines	1. The process water is settled to remove salable coal fines 2. The process water is neutralized with lime for reuse and to prevent stream pollution
Remarks	Using lime in treating mine water gives low cost of treatment, fast reactivity, good removal of iron and sulfur, but produces sludge. Method 3 above requires large amounts of water. Method 4 has given good results. Method 2 has given indifferent results on attempts to recover iron oxide, blanc fixe, etc.	Lime and swollen potato starch are used to improve filtration and settling properties. Lime neutralization also decreases the corrosion of equipment that handles the process water

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 12.

TABLE 12-20. DAIRY WASTES*

	Type of plant						
	Receiving station	Bottling works	Cheese factory	Creamery	Condensery	Dry milk	Ice cream
Composition of wastes							
Total solids	1,141	1,483	1,528	2,422	2,793	2,407	
Suspended solids	.....	536	751	664	754		
BOD, ppm	569	567	998	1,246	1,291	485	
pH	....	5.3	7.0	7.7	7.8		
Character of waste	Whole-milk washings	Whole-milk washings	Whey, casein, washings	Buttermilk, washings	Spoiled-milk washings	Same as condensary	Casein, milk washings
Methods of treatment	Dilution, irrigation	Physical filtration	Biochemical process (Mallory)	Chemical precipitation and activated-sludge processes (Guggenheim)		Same as bottling works	
Remarks	All methods of treatment seem to be standardized. The Mallory and Guggenheim processes require lime in the course of chemical precipitation, and both give good results for decreasing BOD and total solids, the former decreasing BOD by 99% and solids by 50% and the latter decreasing by 90% and 50%, respectively. Lime can be used to coagulate waste from caustic washing of milk bottles. Addition of lime, copperas, aluminoferric, and mixtures of these chemicals are sometimes used to purify any wastes containing milk washings						

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 18.

Abstract (continued)

TABLE 12-21. WASTES FROM EXPLOSIVE-MANUFACTURING PLANTS*

	Item manufactured			
	TNT		TNP	Smokeless powder
	Type of waste			
	Red	Yellow	Wash	Composite
Composition of waste	H_2SO_4, HNO_3, TNT isomers	Na_2SO_3, TNT isomers	Picric acid, H_2SO_4, HNO_3	Copper, zinc, soap solutions cleansers, lubricants, H_2SO_4, nitrogen
Character of waste	Odorless, low BOD biologically stable, acid and alkaline, turbid		Turbid, acidic, low BOD odorless	Highly turbid, acidic low BOD odorless
Methods of treatment	The wastes are mixed, diluted, and added to the sewer. The main problem is color removal		Same as TNT, except lower dilutions (1 to 650) are used than in TNT (1 to 10,000)	Lime is added to wastes, which neutralizes and settles out grease, copper, and zinc. Effluent goes to sewer and sludge is lagooned. Effective pH is 10 or over
Remarks	Dilution seems to be the most inexpensive answer to the problem. Chemical treatment is costly and only alum has shown any success as a coagulant in published results. Lime may be used to neutralize H_2SO_4 and HNO_3, from general plant drainage and product washing			Lime is the best method for chemical treatment from a cost and sludge-disposal standpoint. Acidity of waste favors use of lime

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 19.

TABLE 12-22. WASTES FROM FERMENTATION INDUSTRIES*

	Type of plant			
	Brewery	Distillery		Winery
		Malting	Distilling	
Character of wastes	Organic; yeast in solution and grain suspended; high BOD (to 1,000)	Organic, high in nitrogen, low BOD	Organic, acidic, very high BOD, total solids	Organic, high BOD sugars, fruit pulp
Methods of treatment	Filtered, settled; effluent discharged and solids sold as stock feed	Same as brewery except that solids are sold as fertilizer too	Same as brewery	Fruit pulp treated with lime and $CaCl_2$ to recover tartrates. Solids sold as fertilizer
Remarks	Physical treatment as given above seems satisfactory. Lime may be used to coagulate wastes from bottle and equipment washing. Lime as a filtration improver after primary filtration			

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* The Use of Lime in Industrial Waste Treatment. *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 20.

Abstract (continued)

TABLE 12-23. LAUNDRY WASTES*

Composition of waste	Grease, dirt, starch, soda ash, soap
Character of waste	Turbid, highly alkaline, readily putrescible, and BOD of 400-1,000 ppm
Methods of treatment	Biological filtration and chemical precipitation (lime, alum, and ferric chloride or sulfate with sulfuric acid, to adjust pH). Under present laws, dilution is satisfactory
Remarks	Use of lime prohibited because of nature of wastes, unless chemical processing as above is absolutely necessary. Grease removed and BOD reduced by coagulation with $MgSO_4$ and lime, or zeolite regeneration water and lime

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 21.

TABLE 12-24. PETROLEUM WASTES*

	Type of waste					
	Drilling	Oil storage	Distillation	Treating	Recovery	Miscellaneous
Composition of wastes	Oil; brine, sodium, calcium, magnesium, chlorine, SO_4, bromine	Organic sulfur compounds, acids, H_2S, SO_2; inorganic salts, sodium, chlorine, magnesium, calcium, sulfur, emulsions	Organic sulfur and nitrogen compounds, inorganic salts and alkalies, phenols, soaps, emulsions	Same as distillation and lead, copper, calcium, and naphthenic acid	Same as distillation, and mercaptides, organic esters, and iron and sulfur compounds	Oil; inorganic chemicals, HF (alkylation)
Methods of treatment	Separators, skimming tanks, evaporators, seepage, repressure producer wells	Same as drilling	Settling tanks, filters, reuse of caustic, evaporation	Same as distillation and recovery by distillation	Same as treating	Same as drilling. HF neutralized with lime
Remarks	Lime may be used to break oil emulsions preparatory to sending water to sewer; separated oil sent to seepage areas or used to repressure wells			Organic compounds used in recovery of treating chemicals. Lime may be used to neutralize H_2SO_4 and sludge if recovery is not feasible	Lime may be used to remove iron and sulfur	Includes composite from water softening, heat exchangers, and general drainage

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C), Apr. [illegible]

Abstract (continued)

TABLE 12-25. PICKLING LIQUORS*

	Type of waste	
	Steel	Stainless steel
Composition of wastes	Sulfuric acid, ferrous and ferric iron	Sulfuric, nitric and hydrochloric acids, and iron salts
Character of wastes	Highly acidic, inorganic, toxic	Same as steel
Methods of treatment	1. Dilution and disposal to sewer 2. Neutralize with lime 3. Neutralize with lime and pond sludges 4. Cesspool or lagoon wastes 5. Recover copperas and H_2SO_4 or H_2SO_4 and hydrated ferrous sulfates, or ferric sulfate, or iron oxide, and others 6. Produce constructional material (Ferron process)	1. Same as methods 1–4, steel 2. Treat with lime to recover $Ca(NO_3)_2$, $CaCl_2$, or $Ca_3(PO_4)_2$, and metal oxide sludge
Remarks......	Method 1 would use large quantities of water. Method 5 and similar processes are still largely in an experimental stage. None use lime. Method 6 uses lime and has potentialities	Method 2 is still in the experimental stage, but shows promise since calcium nitrate has value as a fertilizer

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 16.

Abstract (continued)

TABLE 12-26. PLATING WASTES*

	Type of waste	
	Copper plating	Chromium plating
Composition of wastes (typical analysis)	NaCN.... 15,200 ppm Na_2CO_3... 60,000 ppm Copper... 26,300 ppm	Total chromium..... 205 ppm Chromium plus 6.... 200 ppm Copper.............. 3.0 ppm Nickel.............. 0.7 ppm Iron................ 0.4 ppm SO_4................ 275 ppm CN.................. 0.8 ppm Mineral acid...... 208.0 ppm
Character of waste.....	Inorganic, toxic	Inorganic, toxic
Methods of treatment†.	1. Add H_2SO_4 and volatilize HCN gas 2. Add commercial lime-sulfur solution. Very good, CN goes to thiocyanate, definite yellow precipitate indicates complete reaction. Lime removes soda ash by precipitation 3. Acidic CN wastes treated with lime and copperas	1. Reduce Cr plus 6 and precipitate hydrate chromic oxide H_2O_2, Na_2O_2, $KMnO_4$; followed by lime, Na_2CO_3, $BaCO_3$, $Ba(OH)_2$ 2. Direct chemical precipitate of Cr plus 6. Na_2S, BaS, $FeSO_4$, or scrap Fe; followed by lime to neutralize 3. Miscellaneous precipitation, coagulation, and elutriation
Remarks.............	Method 2 seems to give the best results. Method 1 will contaminate the atmosphere as a result of volatilization. Method 3 is a batch process, as is method 2	The BaS method (method 2 above), followed by adding lime to pH 7.0 is easiest to observe and control. Products are precipitate containing $BaCrO_4$, $BaSO_4$, hydrated chromium oxide, and some sulfur. Cyanide can be removed in a related step as harmless salts or double salts

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[*] The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 13.

[†] Treating a combination of these two wastes consists of contacting the chromium wastes with iron to reduce Cr plus 6, followed by lime treatment and addition of CN wastes.

Abstract (continued)

TABLE 12-27. PULP AND PAPER WASTES*

	Type of plant				
	Pulp			Paper	Board (straw and paper)
	Soda	Sulfate	Sulfite		
Composition of waste	Lignin, resins, soda, ash, fiber, ink†	Lignin, resins, mercaptans, sulfides, disulfides, sulfates, soaps, tall oil, terpenes, fiber, ink†	Lignin, resins, carbohydrates, proteins, fats, CaO, SO_2, ink†	Sizing material, fillers, adhesives, fiber	Fibers, trash, garbage, nitrogen, PO_4
Character of waste	Organic, inorganic, toxic, suspended, and dissolved solids			See pulp	Slightly acidic, low BOD, organic
Methods of treatment	Waste liquors evaporated, burned, leached, causticized with lime, diluted with raw black liquor, and stored for reuse in the digester. Carbon and $CaCO_3$ from above used for activated carbon and calcined for causticization, respectively		1. Dilute 2. Fractional precipitation or Howard process 3. Evaporate and use as fuel (Paulson process) 4. Produce by-products: yeast, alcohol, fertilizer, acetone, etc.	1. Recirculation of wastes 2. Chemical precipitation 3. Ponding 4. Filtration	Suspended solids (30%) removed by filtration or chemical coagulation, effluent discharged
Remarks....	The above general process is necessary for the economic operation of the processes. Still, after treatment, the waste will consist of lignin, which must be removed		Methods 2 and 4 show the best futures. Both use lime and so are being given the most attention	Method 1 above is most extensively used since it cuts down BOD as much as 90%. Lime is used as a coagulant and filtration conditioner on white water wastes	Lime may be used in chemical coagulation

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 14.

† If deinking is part of process, these wastes may be combined with other wastes or treated by coagulation and sedimentation. Lime is best chemical coagulant for deinking waste treatment.

TABLE 12-28. RAYON WASTES*

	Type of waste	
	Acidic	Alkaline
Composition of wastes	H_2SO_4, Na_2SO_4, $ZnSO_4$, HCl, $NaHSO_4$, H_2S	Sulfides and polysulfides, colloidal sulfur, NaOH
Character of wastes	Acidic, inorganic, low BOD corrosive	Alkaline, inorganic, high BOD
Methods of treatment	The waste is split with one portion going to neutralize the alkaline waste. The other portion is treated with lime to form $CaSO_4$, which is dewatered and ponded	The waste is neutralized with a portion of the acid waste or it is oxidized in trickling filters to sulfates and thiosulfates
Remarks......	The above methods of treatment seem to be generally standard for disposing of rayon-plant wastes. Rayon-finishing wastes are treated with ferric sulfate and lime in a settling tank to remove 65% BOD, after which the effluent is discharged to secondary settling tank. The effluent from the latter tank is discharged at an even rate into the sewer	

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* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 15.

Abstract (continued)

TABLE 12-29. SLAUGHTERHOUSE AND PACKING-HOUSE WASTES*

	Suspended solids	Organic nitrogen	BOD, ppm
Type of waste:			
Killing floor	220	134	825
Blood and tank water	3,690	5,400	32,000
Scalding tub	8,360	1,290	4,600
Meat cutting	610	33	520
Gut washer	15,120	643	13,200
Sausage department	560	136	800
Lard department	180	84	180
By-products	1,380	186	2,200
Character of wastes	Organic, contain grease, hair, flesh, blood		
Methods of treatment	1. Screening and dilution 2. Screening, grease removal, manure removal, and dilution 3. Method 2 and chlorination followed by sedimentation instead of dilution 4. Biological filtration instead of chlorination 5. Chemical precipitation using lime and alum or ferric chloride to remove suspended solids and some BOD		
Remarks	Residual BOD after screening, grease removal, coagulation, and sedimentation is largely removed by chlorination, which precipitates dissolved protein. Generally, mechanical and/or biological processes are employed		

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 22.

TABLE 12-30. TANNERY WASTES*

	Type of waste	
	Vegetable	Chrome
Composition of wastes	Lime sludge, hair, fleshing, tan liquor, bleach liquor, salt, blood, dirt	Lime sludge, hair, fleshing, chrome, tan liquor, salt, blood, dirt
Character of wastes	Organic and inorganic, pH 7 plus or minus; high BOD; chrome wastes are higher in dissolved solids, smaller in volume, and lower in BOD	
Method of treatment	The wastes are segregated; all washes are combined. The remaining wastes are combined and allowed to settle. The effluent from this sedimentation is mixed with the total wash water and sent to the sewer. Sludge from sedimentation is lagooned to dewater it and sold for fertilizer	
Remarks	The above method of treatment has been found satisfactory in all cases. Secondary treatment using chemical precipitation has been tried and has been successful but expensive. Processes have included flue gas (CO_2) and lime, sulfuric acid or sulfur dioxide and alum or lime or both, flue gas and ferric chloride, and sulfuric acid and ferric chloride	

* The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington D.C.), Apr. 1, 1948, p. 24.

Abstract (continued)

TABLE 12-31. TEXTILE WASTES[*]

	Type of waste			
	Deterging	Bleach	Miscellaneous	Dyeing
Composition of wastes	Scouring detergents, mineral matter, wool grease and sweat, textile fibers	Spent bleach, sulfuric acid, textile fibers, mineral matter	1. Starch, H_2SO_4, NaOH, malt (desizing) 2. NaOH, H_2SO_4 (mercerizing) 3. Tin and iron salts, (weighting) 4. H_2SO_4, vegetable matter (carbonizing)	Direct, acid, basic, sulfur, vat dyes; NaCl, Na_2SO_4, starch
Character of wastes	High in organic, alkaline (high), high suspended solids, easily putrescible, high BOD	Slight alkaline, low BOD high suspended solids, inorganic and organic	1. Desizing, low volume, organic, alkaline 2. Mercerizing, alkaline, inorganic 3. Weighting, alkaline or acid, inorganic All have low BOD	Alkaline or acid, inorganic and organic, low BOD
Methods of treatment	Wool-scouring wastes alone treated by adding lime followed by chlorine, or calcium hypochlorite, after being degreased. The treated waste is settled and effluent discharged	Decolorized (mixed with dye wastes)	Caustic recovered. Lime used to precipitate tin in weighting wastes	1. Dye wastes may be treated with copperas and lime to give good effluent 2. Decolorized (mixed with bleach wastes)
	After or without the above pretreatments, the wastes are combined and coagulation, sedimentation, and sludge removal are performed. Lime is the most common of the coagulants, being used alone or with chlorine, alum, iron sulfates, and ferric chloride. High-calcium lime is generally preferred. Primary treatment may be followed by biological filtration and secondary sedimentation			
Remarks	Lime is being used for some part of total treatment in practically every textile-waste-treatment plant			

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[*] The Use of Lime in Industrial Waste Treatment, *Trade Waste Bulletin* 1 (National Lime Association, Washington, D.C.), Apr. 1, 1948, p. 17.

Disease/Solid Waste
Abstracts

No. DSW-247

Author

Hugh E. Eisenhauer

Title

Chemical Removal of ABS from Wastewater

Effluents

Reference

J. Water Poll. Con. Fed., Nov, 1965, Vol. 37,

Doc. No. **Contract No.** **Date issued**

No. 11, pp. 1567

Abstract

The most common synthetic detergent, alkylbenzenesulfonate (ABS), can be completely assimilated by biological oxidation systems only over an extended period of time. As a result, ABS is only partially destroyed by the normal secondary wastewater treatment process.

Catalysts other than ferrous ammonium sulfate and ferrous sulfate were evaluated with hydrogen peroxide and the standard ABS solution. The results of the evaluation, which was conducted both with other ferrous salts and salts of other reduced metals, are given in Table III. The poorer results obtained with ferrous chloride are presumably due to the inhibiting effect of the choride ion. All the other catalysts evaluated were inferior to ferrous ammonium sulfate and ferrous sulfate under the reaction conditions of the standard method.

It has been demonstrated that the ABS content of wastewater and laundry wastes can be reduced effectively by using hydrogen peroxide in combination with ferrous sulfate catalyst. With a ferric sulfate pretreatment, the chemical cost to treat laundry effluents is reasonable. The treated effluents are substantially free of both ABS and the phosphate builders. Therefore, the pollutional effects of both these detergents ingredients can be reduced by the peroxide treatment method.

During 1965, most detergent manufacturers are expected to convert their facilities to the production of biodegradable detergents containing LAS. Most authorities agree that LAS will be degraded effectively by the biological action in secondary wastewater treatment plants. However, others have suggested that, under practical operating conditions, biodegradation efficiency will be significantly reduced (13). Furthermore, LAS subjected to the strictly anaerobic digestion in septic tank systems may not degrade appreciably even though recent work (14) has

Descriptors

ABS
removal

wastewater
oxidation

Abstract (continued)

indicates a high degree of biological degradation in those septic systems percolation fields where aerobic bacteria can survive. In those areas where wastewater receives primary treatment only or is discharged directly to waterways, the introduction of LAS will have little effect on the elimination of foam problems. Regardless of treatment, LAS detergents will all contain the same phosphate builders that ABS detergents contain, and these will be discharged unabated into the receiving waters.

In consideration of the foregoing, the peroxide method is recommended for the treatment of concentrated detergent wastewater effluents such as those discharged by commercial or self-service laundries. As indicated previously, the process will remove ABS or LAS as well as the phosphate builders. Such a process would be particularly useful for the treatment of those laundry effluents which would not receive subsequent treatment in a secondary wastewater treatment plant. Moreover, there appears to be some uncertainty in the trade literature concerning the completeness of the proposed changeover to LAS by the detergent industry. If significant quantities of ABS continue to be marketed, the peroxide method may be used to help alleviate the pollutional effects of undegraded detergent residues.

TABLE III.—Evaluation of Reduced Metal Salt Catalysts

Catalyst	Residual ABS (mg/l)	
	After 30 Min Reaction	After 5 Hr Reaction
$Fe(NH_4)_2(SO_4)_2$	5.2	2.7
$FeSO_4$*	4.9	1.9
$FeCl_3$†	11.9	10.5
CuCl	38.1	39.6
$TiCl_3$	35.7	15.8
$VOSO_4$	16.6	16.5
$CoSO_4$	38.4	37.4
$MnSO_4$	39.3	38.2

* Commercial sugar copperas.
† pH adjustment with dilute HCl

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(13) Winton, J., "The Detergent Revolution." Chem. Week. 94, 22, 111 (1964).
(14) Test Compares Detergent Degradabilities", Chem. Eng. News, 42, 30, 44 (1964).

Disease/Solid Waste
Abstracts

No. DSW-248

Author

Samuel A. Hart & Marvin E. Turner

Title

Lagoons for Livestock Manure

Reference

J. Water Poll. Con. Fed., Nov, 1965. Vol. 37,

Doc. No.	Contract No.	Date issued
No. 11, pp. 1578		

Abstract

Tremendous quantities of manure are produced each day, and disposal is hampered by its sheer volume and by lack of land on which it can be spread. The manure is not even readily disposed of to nearby crop farmers because hauling and spreading manure frequently costs more than the use of chemical fertilizers. Many livestock farmers would gladly accept a system that destroys the manure rather than be faced with the logistics of collection, processing, storing, marketing, hauling and spreading it. Thus, lagoons have been considered seriously and attempted as a method of reducint the manure management chore.

The objective of treatment is destruction and stabilization of the organic matter rather than water purification. The BOD loading rate may be as high as 1,000 to 1,200 lb/day/acre (1,120 to 1, 350 kg/day/ha). Anaerobic phenomena predominate, so manure lagoons are more appropriately compared to open-topped, unheated, municipal sludge lagoons, or perhaps even to conventional sludge digesters, than they are to sewage lagoons.

Poultry, swine, and cattle manures are different from one another, yet all are unlike municipal sewage solids. Livestock feeds are made from hay, unmilled grains, and various by-product supplements. Their digestibility and utilization within the animal depends on fineness of grind, whether the animal is a ruminant, and a myriad of husbandry aspects. The resulting manures all are high in lignaceous and fibrous organic matter, yet have relatively high BOD's. Each manure is different in its physical and biological characteristics, and the usual design parameters do not delineate livestock manure treatment well.

The farmer evaluates the acceptability of manure lagoons on the basis of odors, fly control, effectiveness in accepting and destroying organic matter, and appearance, in roughly that priority. Health officials and regulatory agencies use

Descriptors

lagoons
disposal
manure

Abstract (continued)

these same criteria and, additionally, are very much concerned with the amount of any surface or seepage effluent.

Lagoons have a great deal of appeal, at least to California farmers, in that they can eliminate or significantly reduce fly problems from manure. The poultry manure fed to the lagoons often was infested with *Musca* larvae and pupae; these floated to the surface, and, though some emergence of adults did occur, most maggots drowned and the pupae were waterlogged.

All lagoons except Lagoon A supported dronefly larvae, *Tubifera tenax*, at one time or another. The heavily loaded poultry manure lagoons were significant sources of these flies. At present, however, the dronefly is not considered an important public health or nuisance hazard since it is not attracted to human habitation. Thus, moderate breeding of droneflies would not bar lagoons presently.

Lagoon A, the lightly loaded poultry unit, supported large numbers of mosquito larvae. It was necessary to kill these larvae every week in summer by pouring on a thin layer of kerosene or by using insecticides. This was the only lagoon that supported mosquitoes. Mosquito production would be less serious in a farm lagoon because wind reduces both the egg-laying opportunity and the emergence of adults. Additionally, if such a light loading and essentially aerobic surface conditions could be afforded on the farm, it might be possible to cultivate mosquito fish. This side issue was attempted unsuccessfully in this study.

In sum, manure lagoons do improve sanitation with respect to flies over what would occur with otherwise mismanaged manure.

In sum, the materials balance on the poultry manure lagoons plus the appraisal of the dairy and swine manure lagoons leads to three conclusions:

1. Lagoons effect a considerable reduction in the total and organic solids content of manure.
2. Lagoons effect a nearly complete reduction of the BOD.
3. These reductions occurred through both biological degradation and infiltration loss. A properly constructed, impermeable lagoon will have only degradation losses, but these will be considerable in themselves.

Unquestionably, lagoons are simple to construct and to operate; this study also showed that lagoons do accept and dispose of large amounts of manure and furnish long-term storage for the retained solids. The subjective criteria of odors and appearance are much harder to measure and to relate to acceptability. Additionally, the unexpected problem of infiltration loss and pollution of the underground waters must be considered.

Infiltration may well control whether a lagoon can be used for manure disposal. The excessively large infiltration loss measured from this experiment was an unexpected problem.

If infiltration does not control the existence of a lagoon, then odors will be the major factor which will control its loading rate. A malodorous atmosphere will not be tolerated long.

Lagoons should be deep. The farmer cannot affort the water or the lagoon surface and volume to use aerobic, photosynthetic reactions for manure stabilization. Thus, shallowness is of no avail, since it only increases the surface from which

Abstract (continued)

odors emanate. But, more important, a deep lagoon will be far more effective in keeping the manure on the bottom undergoing strict anaerobic degradation and keeping surface less polluted and thus less odorous. We think manure lagoons can well be 8-, 10-, or 12-ft deep (250-, 300-, or 350-cm deep) if infiltration loss is not encouraged by such depths and if it is safely fenced to prevent accidents.

TABLE I.—Livestock Manure Characteristics

Item	Poultry	Cattle	Swine
Total solids (TS) in feces and urine* (lb/day/animal)	0.066	10.44	0.795
(g/day/animal)	30.0	4.730	360
Volatile solids (VS) (% of TS)	77.5	80.3	78.5
5-day BOD (mg BOD/mg VS)	0.288	0.183	0.320
COD (mg COD/mg VS)	1.11	1.0	1.2
Total nitrogen, as N (% of TS)	5.4	3.7	4.0
NH_4 nitrogen (% of total N)	74	--	75
Phosphorus, as P_2O_5 (% of TS)	4.6	1.1	3.1
Potassium, as K (% of TS)	2.1	3.0	1.4
Volatile acids (as acetic) (% of TS)	5.8	3.2	4.8

* Quantity depends on the size of the animal; the above figures are for a 5-lb (2.2-kg) chicken (usual egg-laying size), a 1,000 lb (454-kg) bovine (small dairy cow or marketable beef animal), and a 100-lb (45-kg) swine (half grown to market size).

TABLE III.—Materials Balance Data for Manure Lagoons

Line	Item	Poultry Manure Lagoons					Dairy Manure Lagoons			Swine Manure Lagoons		
		A	B	C	D	E	F	G	H	J	K	L
1	Total solids fed (lb)*	138.3	406.1	662.2	943.9	1,168.6	208.1	5[illegible]4.3	457.0	110.0	217.7	325.4
2	Total solids recovered at end (lb)*	34.9	98.0	301.0	190.4	362.[illegible]						
3	Degradation and loss of TS (%)	74.7	76.0	54.2	79.9	69.0						
4	Volatile solids fed (lb)*	99.4	229.8	506.0	723.8	898.9	156.9	2[illegible]9.0	353.4	84.1	168.4	251.4
5	Degradation and loss of VS (%)	78.9	80.5	65.1	85.8	84.9						
6	Inorganic (non-volatile) solids fed (lb)*	38.9	106.2	156.2	220.0	269.7	51.2	75.3	103.6	25.9	49.3	74.0
7	Loss (by infiltration) of inorganic solids (%)	64.2	62.8	18.2	60.2	45.3						
8	BOD fed (lb)*	23.6	80.3	139.6	199.6	249.7	26.0	42.6	61.2	26.0	52.0	79.1
9	Degradation and loss of BOD (%)	96.6	96.6	92.5	96.9	94.6						
10	Volatile acids fed (lb)*	4.2	15.5	22.7	40.0	50.6	6.7	10.6	15.1	5.2	10.6	15.9
11	Degradation and loss of volatile acids (%)	87.0	91.8	97.7	95.7	96.0						
12	Nitrogen (N) fed (lb)*	5.1	18.8	33.6	48.1	61.0	7.7	12.0	16.8	4.5	9.0	13.5
13	Loss of nitrogen (%)	76.4	74.7	61.3	79.1	60.8						
14	Phosphorus (P_2O_5) fed (lb)*	4.3	15.9	28.6	41.3	52.0	2.2	3.5	4.9	3.4	6.8	10.2
15	Loss of phosphorus (%)	64.8	63.3	25.0	51.4	16.4						
16	Potassium (K) fed (lb)*	2.0	7.2	13.0	18.7	23.6	6.2	10.5	13.8	1.5	3.0	4.5
17	Loss of potassium (%)	90.5	87.2	43.0	80.7	71.8						
18	Average infiltration of water (in./day)†	2.7	1.1	1.5	2.2	2.0	2.6	1.7	1.7	1.0	0.7	0.5
19	Infiltration rate at end (in./day)†	2.1	0.7	1.0	0.4	0.1	1.2	0.7	0.7	0.6	0.5	0.4

* Multiply by 0.454 to obtain kg.
† Multiply by 2.54 to obtain cm/day.

Disease/Solid Waste
Abstracts

No. DSW- 249

Author

McCabe, Brother J. and Eckenfelder, W.W.

Title Biological Treatment of Sewage and Industrial Wastes. Vol. 11--Anaerobic

Digestion and Solids Liquid Separation. 1958.

Reference Reinhold Publishing Corp. 1958

Doc. No. **Contract No.** **Date issued**

Abstract

Digested sewage sludge leaves much to be desired from the standpoint of hygienic quality. ...it would seem logical that a significantly greater number of pathogens will escape in the discharge from a primary digester operated on a high-rate basis than would be the case where intimate mixing is not practiced.

Langley (3) has investigated the survival of S. schottmuelleri and S. typhosa in high-rate units operated in parallel at 6 and 20 days detention. He found that 7.5 and 6.7 percent, respectively, of the organisms survived after 1 day in the digester operated at 6 days detention and that 0.40 and 0.22 percent, respectively, survived after 1 day in the digester operated at 20 dayd detention. This would seem to verify the hypothesis that hygienic quality will deteriorate rapidly as detention time is reduced. However, in a study involving the feeding of sludge enriched with S. typhosa over a 24-day period, the sludge from the 6-day detention digester contained only 2.36 times as many surviving organisms as were found in the sludge from the 20-day detention unit. No studies were conducted on the more resistant forms such as B. tuberculosis, E. histolytica, Ascaris eggs or helminth ova.

Descriptors

sewage
S. schottmuelleri
treatment
industrial waste

sludge
S. typhosa
biological
separation

Abstract (continued)

TABLE 1-1. APPROXIMATE ORGANIC ANALYSIS OF FRESH SOLIDS AND RIPE SLUDGE[a]

	Fresh Solids[b] (%)	Ripe Sludge[b] (%)
Ether-soluble	34.40	8.18
Soluble in cold and hot water	9.52	5.48
Alcohol-soluble	2.49	1.56
Hemicellulose	3.20	1.58
Cellulose	3.78	0.56
Lignin	5.78	8.37
Crude protein	27.12	19.68
Ash	24.13	56.00
Total	110.42	101.44

[a] According to Heukelekian.[14]
[b] Per cent of dry solids.

TABLE 1-2. ANALYSIS [illegible] AND [illegible] SLUDGE[a]

	[illegible] (%)	Ripe Sludge[b] (%)
Protein (N × 6.25)	19.4	12.5
Grease	25.2	6.9
Crude fiber	10.8	9.8
Humic acids	4.0	8.6
Summation	59.4	57.4
Volatile matter by analysis	60.9	39.5

[a] According to Buswell and Neave[8]
[b] Per cent of total solids.

Disease/Solid Waste
Abstracts

No. **DSW-** 250

Author

M. Arnold Kershaw

Title

Developments in Sludge Treatment and Disposal at the Maple Lodge Works, England

Reference

J. Water Poll. Con. Fed., May 1965, Vol. 37, No. 5, pp.674

Doc. No. **Contract No.** **Date issued**

Abstract

1. The sludge drying bed installation, as described in this paper, has operated in a satisfactory manner during the first year but by conventional methods the output has been low. It is possible that this is due to the nature of the sludge, partly due to weather conditions, and partly to the fact that on this installation accurate measurement of output is possible.

2. Provisionally it would seem that the application of about 80,000 lb (36,300 kg) dry solids per bed will give the maximum output, taking into account the limit on cake thickness imposed by the sludge lifter. Applying a sludge of 4-percent dry-solids content this means pumping approximately 250,000 gal (910,000 l) of sludge to fill a bed to a nominal depth of 8 in. (20 cm).

3. The 32-ft (9.7-m) spacing of the inlets to the beds and the 40-ft (12.2-m) bed width appear to be very satisfactory, giving even distribution over the whole surface of the bed.

4. The year's operation has proved that it is necessary to take the sludge to a much drier state for machine lifting than is the case where manual lifting is used on drying beds.

5. There is no doubt that machine lifting at Maple Lodge is successful mechanically and, what is more important, the labor saving makes it an attractive method of sludge dewatering.

6. A further advantage of the system is the great time saving at the time of emptying. This is achieved in about 3-1/2 hr, which makes it possible to empty and refill a drying bed in the course of a normal day.

7. Finally, although more expensive than the direct disposal of liquid digested sludge onto farmland, generally it is felt that a combination of sludge drying beds equipped with mechanical lifting and storage conveyors and tanker disposal of liquid digested sludge direct to land will provide the Board with the most satisfactory methods of sludge disposal, and will give a more desirable measure of flexibility of operation.

Descriptors

sludge
sludge dewatering
dry solids
disposal
machine lifting
treatment

Disease/Solid Waste Abstracts

No. **DSW-**251

Author

Nelson Leonard Nemerow

Title

Theories and Practices of Industrial Waste Treatment

Reference

Addison-Wesley Pub. Co., Inc. 1963

Doc. No.	**Contract No.**	**Date issued**

Abstract

Section 1 contains basic facts which the industrial waste engineer needs to know: effect of wastes on the surrounding environment, how wastes can be reduced by proper plant operation, how to calculate the final treatment required before disposal into a receiving stream, how to sample the stream to ascertain the waste treatment required or the efficiency of existing treatment, and finally, how to protect the stream from further pollution.

Section 2 delves into the theories of waste treatment. Section 2...discusses not only removal of suspended and colloidal solids, but also neutralization, equalization, and proportioning, and removal of inorganic dissolved salts. The theories are similar to those expressed by other authors, since theories have not changed very much. However, this section does present new ideas for the removal of dissolved organic solids.

Section 3 accentuates engineering practice, and presents concrete examples of problems and their solutions. Theories seldom work in practice exactly as set forth on paper; and quite often in this field they never work at all. The reasons for this are numerous. Economics, public opinion, personality differences, local laws or customs, previous community experiences with certain industrial wastes, contradictory advice of the consulting engineer, views of the local industrial development board, and many other factors, help determine whether even well-conceived theories can be put into practice.

The basic question underlying this section is whether to treat industrial wastes separately or in conjunction with municipal sewage systems.

Section 4 gives separate treatises on all the major liquid industrial wastes - ....apparel, food-processing, materials, chemicals, and energy . its origin, characteristics, and more acceptable treatments

Descriptors

fertilizer
odors
fly ash
waste liquor
garbage
thickening
sulfides
dissolved solids

dewatering
insect breeding
oxidation
flash drying
refuse
laundry wastes
chlorides
phenolic compounds

weed growth
limestone
slurry
soil conditioner
flotation
pulp waste
mercaptans
cresylates

Abstract (continued)

SUMMARY OF INDUSTRIAL WASTE: ITS ORIGIN, CHARACTER, AND TREATMENT

Industries producing wastes	Origin of major wastes	Major characteristics	Major treatment and disposal methods
Food and Drugs			
Canned goods	Trimming, culling, juicing, and blanching of fruits and vegetables	High in suspended solids, colloidal and dissolved organic matter	Screening, lagooning, soil absorption or spray irrigation
Dairy products	Dilutions of whole milk, separated milk, buttermilk, and whey	High in dissolved organic matter, mainly protein, fat, and lactose	Biological treatment, aeration, trickling filtration, activated sludge
Brewed and distilled beverages	Steeping and pressing of grain, residue from distillation of alcohol, condensate from stillage evaporation	High in dissolved organic solids, containing nitrogen and fermented starches or their products	Recovery, concentration by centrifugation and evaporation, trickling filtration; use in feeds
Meat and poultry products	Stockyards, slaughtering of animals, rendering of bones and fats, residues in condensates, grease and wash water, picking of chickens	High in dissolved and suspended organic matter, blood, other proteins, and fats	Screening, settling and/or flotation, trickling filtration
Beet sugar	Transfer, screening and juicing waters, drainings from lime sludge, condensates after evaporator, juice, extracted sugar	High in dissolved and suspended organic matter, containing sugar and protein	Reuse of wastes, coagulation, and lagooning
Pharmaceutical products	Mycelium, spent filtrate, and wash water	High in suspended and dissolved organic matter, including vitamins	Evaporation and drying; feeds
Yeast	Residue from yeast filtration	High in solids (mainly organic) and BOD	Anaerobic digestion, trickling filtration
Pickles	Lime water, brine, alum and tumeric, syrup, seeds and pieces of cucumber	Variable pH, high suspended solids, color, and organic matter	Good housekeeping, screening, equalization
Coffee	Pulping and fermenting of coffee bean	High BOD and suspended solids	Screening, settling, and trickling filtration
Fish	Rejects from centrifuge, pressed fish, evaporator and other wash water wastes	Very high BOD, total organic solids, and odor	Evaporation of total waste, barge remainder to sea
Rice	Soaking, cooking, and washing of rice	High in BOD, total and suspended solids, (mainly starch)	Lime coagulation, digestion
Soft drinks	Bottle washing, floor and equipment cleaning, syrup-storage-tank drains	High pH, suspended solids and BOD	Screening, plus discharge to municipal sewer
Apparel			
Textiles	Cooking of fibers, desizing of fabric	Highly alkaline, colored, high BOD and temperature, high suspended solids	Neutralization, chemical precipitation, biological treatment, aeration and/or trickling filtration
Leather goods	Unhairing, soaking, deliming and bating of hides	High total solids, hardness, salt, sulfides, chromium, pH, precipitated lime and BOD	Equalization, sedimentation, and biological treatment

Abstract (continued)

SUMMARY OF INDUSTRIAL WASTE: ITS ORIGIN, CHARACTER, AND TREATMENT (*Continued*)

Industries producing wastes	Origin of major wastes	Major characteristics	Major treatment and disposal methods
Laundry trades	Washing of fabrics	High turbidity, alkalinity, and organic solids	Screening, chemical precipitation, flotation, and adsorption
Chemicals			
Acids	Dilute wash waters; many varied dilute acids	Low pH, low organic content	Upflow or straight neutralization, burning when some organic matter is present
Detergents	Washing and purifying soaps and detergents	High in BOD and saponified soaps	Flotation and skimming, precipitation with $CaCl_2$
Cornstarch	Evaporator condensate, syrup from final washes, wastes from "bottling up" process	High BOD and dissolved organic matter; mainly starch and related material	Equalization, biological filtration
Explosives	Washing TNT and guncotton for purification, washing and pickling of cartridges	TNT, colored, acid, odorous, and contains organic acids and alcohol from powder and cotton, metals, acid, oils, and soaps	Flotation, chemical precipitation, biological treatment, aeration, chlorination of TNT, neutralization
Insecticides	Washing and purification products such as 2,4D and DDT	High organic matter, benzene ring structure, toxic to bacteria and fish, acid	Dilution, storage, activated carbon adsorption, alkaline chlorination
Phosphate and phosphorous	Washing, screening, floating rock, condenser bleed-off from phosphate reduction plant	Clays, slimes and tall oils, low pH, high suspended solids, phosphorous, silica and fluoride	Lagooning, mechanical clarification, coagulation and settling of refined waste
Formaldehyde	Residues from manufacturing synthetic resins, and from dyeing synthetic fibers	Normally has high BOD and HCHO, toxic to bacteria in high concentrations	Trickling filtration, adsorption on activated charcoal
Materials			
Pulp and paper	Cooking, refining, washing of fibers, screening of paper pulp	High or low pH; colored; high suspended, colloidal, and dissolved solids; inorganic fillers	Settling, lagooning, biological treatment, aeration, recovery of by-products
Photographic products	Spent solutions of developer and fixer	Alkaline, contains various organic and inorganic reducing agents	Recovery of silver, plus discharge of wastes into municipal sewer
Steel	Coking of coal, washing of blast-furnace flue gases, and pickling of steel	Low pH, acids, cyanogen, phenol, ore, coke, limestone, alkali, oils, mill scale, and fine suspended solids	Neutralization, recovery and reuse, chemical coagulation
Metal-plated products	Stripping of oxides, cleaning and plating of metals	Acid, metals, toxic, low volume, mainly mineral matter	Alkaline chlorination of cyanide, reduction and precipitation of chromium, and lime precipitation of other metals
Iron-foundry products	Wasting of used sand by hydraulic discharge	High suspended solids, mainly sand; some clay and coal	Selective screening, drying of reclaimed sand
Oil	Drilling muds, salt, oil, and some natural gas, acid sludges and miscellaneous oils from refining	High dissolved salts from field, high BOD, odor, phenol, and sulfur compounds from refinery	Diversion, recovery, injection of salts; acidification and burning of alkaline sludges

Abstract (continued)

SUMMARY OF INDUSTRIAL WASTE: ITS ORIGIN, CHARACTER, AND TREATMENT (*Continued*)

Industries producing wastes	Origin of major wastes	Major characteristics	Major treatment and disposal methods
Rubber	Washing of latex, coagulated rubber, exuded impurities from crude rubber	High BOD and odor, high suspended solids, variable pH, high chlorides	Aeration, chlorination, sulfonation, biological treatment
Glass	Polishing and cleaning of glass	Red color, alkaline non-settleable suspended solids	Calcium chloride precipitation
Naval stores	Washing of stumps, drop solution, solvent recovery, and oil recovery water	Acid, high BOD	By-product recovery, equalization, recirculation and reuse, trickling filtration
Energy			
Steam power	Cooling water, boiler blowdown, coal drainage	Hot, high volume, high inorganic and dissolved solids	Cooling by aeration, storage of ashes, neutralization of excess acid wastes
Coal processing	Cleaning and classification of coal, leaching of sulfur strata with water	High suspended solids, mainly coal; low pH, high H_2SO_4 and $FeSO_4$	Settling, froth flotation, drainage control, and sealing of mines
Nuclear power and radioactive materials	Processing ores, laundering of contaminated clothes, research-lab wastes, processing of fuel, power-plant cooling waters	Radioactive elements, can be very acid and "hot"	Concentration and containing, or dilution and dispersion

TABLE 21-3

INVENTORY OF PROCESS CHEMICALS AND BOD IN WOOLEN-MILL WASTES (AFTER MASSELLI AND BURFORD [71])*

Process chemical	Chemical composition and use	% OWF used			Concentration in effluent, ppm	BOD*	
		Scouring and carding	Finishing	Total		% OWC	% OWF
Soap	Fatty-acid soap; scouring, fulling	2.1	5.5	7.6	152	155	11.7
Soda ash	Na_2CO_3; scouring, fulling	14.2	2.8	17.0	310	0	0
Quadrafos	$Na_6P_4O_{13}$; washing	0.5	0	0.5	10	0	0
Pine oil	Pine oil, washing	0.5	0	0.5	10	108	0.5
Paragon 500	?	0.5	0	0.5	10		
Proxol T	Mineral oil, plus nonionic emulsifier, carding	0.5	0	0.5	10	20	0.1
Acetic acid, 84%	CH_3COOH; dyeing		1.2	1.2	24	62	0.7
Olive sub C3	Oil; spinning	0.4	0	0.4	8		
Sulfuric acid	H_2SO_4, carbonizing, dyeing	0	0.2	0.2	4	0	0
Chrome mordant	$Na_2Cr_2O_7 + (NH_4)_2SO_4$; dyeing	0	0.4	0.4	8	0	0
Chrome	$Na_2Cr_2O_7$; dyeing	0	0.6	0.6	12	0	0
Glauber salt	Na_2SO_4; dyeing	0	0.4	0.4	8	0	0
Monochlorobenzene	C_6H_5Cl; dyeing	0	0.2	0.2	4	3	0
Nopco 1656	Soluble fatty ester; spinning	0	0.2	0.2	4	12	0
Iversol	Blend of soaps, solvents, and detergents; washing	0	1.6	1.6	32	60	1.0
Rinsol	Detergent; washing	0	2.9	2.9	58	72	2.1
Supertex E	Fatty-acid soaps, solvent, cresylic acid; washing	0	0.2	0.2	4	25	0.1
Wool finish B	High carbohydrates and enzymes; finish	0	2.3	2.3	46	57	1.3
	Added impurities, subtotal	18.7	18.5	37.2	748		17.5
	Natural impurities: grease, suint, dirt	150.0	0	150.0	3000	16.7	25.0
	Grand total	168.7	18.5	187.2	3748		42.5

*Per cent OWC is BOD inherent in chemical, based on its weight; per cent OWF is BOD due to the chemical, based on weight of wool.

Abstract (continued)

TABLE 21-12

ANNUAL CONSUMPTION OF PROCESS CHEMICALS IN CATTLEHIDE TANNERY (AFTER MASSELLI, *et al* [32])

	Pounds used	% BOD	Pounds BOD	ppm in waste
Sodium chloride	1,368,000	0	0	684
Sodium chloride (used in curing 19% OWH)	4,408,000	0	0	2,200
Lime	2,470,000	0	0	1,235
Sodium sulfide (62% Na_2S, 25% S^-)	981,000	40	392,000	490
Sulfuric acid	350,000	0	0	175
Soda ash	161,000	0	0	80
Oropon [95% $(NH_4)_2SO_4$]	144,000	5	7,200	72
Calcium formate	88,000	12	11,000	44
Lactic acid (30%)	77,000	32	25,000	38
Sodium formate	56,000	2	1,100	28
Sterizol	42,000			20
Ammonium chloride	20,000	0	0	10
Chemicals absorbed by hide*				
Tanolin R (16% chromium)	1,670,000	0	0	626†
Tamol L	729,000	0	0	36
D-1 oil	37,000	83	3,100	2
Other oils (total of 12)	650,000	80	52,000	33
Quebracho	146,000	5	700	7
Soyarich flour	100,000			5
Tanbark H	88,000	11	1,000	4
Titanium dioxide	88,000	0	0	4
Ade 11 tan	38,000			2
Gambade	156,000	4	600	8
Maratan B	136,000			7
Methocel	20,000	6	120	1
Orotan TV	30.000	5	150	2
Semisol glue	37,000			2
Upper tan	28,000			1
Totals	14,080,000		494,300	5,343

* Absorption estimated at 90%, only 10% discharged to waste. Pounds BOD and ppm in waste are based on 10% of the pounds used.

† Based on 75% discharged to waste.

TABLE 21-13*

COMPARISON OF THE SANITARY CHARACTERISTICS OF COMMERCIAL AND DOMESTIC LAUNDRY WASTES [58]

Analysis	Commercial	Domestic
pH	10.3	8.1
Total alkalinity, ppm	511	678
Total solids, ppm	2114	3314
Volatile solids, ppm	1538	2515
BOD, 5-day, ppm	1860	3813
Oxygen consumed, ppm	868	1045
Grease, ppm	554	1406

* "Commercial" presumably refers to such large-scale operations as linen service for hotels and restaurants, while "domestic" refers to laundries processing home apparel (author).

Abstract (continued)

TABLE 22-8

AVERAGE COMPOSITION OF MILK, MILK BY-PRODUCT, AND CHEESE WASTES

Characteristics	Whole milk, ppm	Skim milk, ppm	Butter-milk, ppm	Whey, ppm	Process wastes, ppm	Sep-arated whey, ppm
Total solids	125,000	82,300	77,500	72,000	4,516	54,772
Organic solids	117,000	74,500	68,800	64,000	2,698	49,612
Ash solids	8,000	7,800	8,700	8,000	1,818	5,160
Fat	36,000	1,000	5,000	4,000		
Soluble solids					3,956	54,656
Suspended solids					560	116
Milk sugar	45,000	46,000	43,000	44,000		
Protein (casein)	38,000	39,000	36,000	8,000		
Total organic nitrogen					73.2	1,300
Free ammonia					6.0	31
Na					807	648
Ca					112.5	350
Hg					25	78
K					116	1,000
P					59	450
BOD, 5-day	102,500	73,000	64,000	32,000	1,890	30,100
Oxygen consumed	36,750	32,200	28,600	25,900		

TABLE 22-22

COMPOSITION OF COFFEE BEAN

Component	Average, %
Water	9-12
Ash	4
Nitrogen	12
Cellulose	24
Sugars	9
Dextrin	1-1.5
Fat	12
Caffetannic acid	8-9
Caffeine	0.7-1.3
Nitrogen-free extract	18
Essential oil	0.7
Water-soluble material	25.3

TABLE 22-29 [AFTER HEUKELEKIAN]

CHARACTERISTICS OF COMPOSITE RICE WASTES

Characteristic	Amount or value
pH	4.2-7.0
Total solids, ppm	1460
Ash solids, %	20.5
Suspended solids, ppm	610
Ash in suspended solids, %	10.8
Total nitrogen, ppm	30
Phosphates, ppm	30
BOD, ppm	1065
Starch, ppm	1200
Reducing sugars, ppm	70

Abstract (continued)

TABLE 23-3

TYPICAL ANALYTICAL RESULTS FOR PULP- AND PAPER-MILL WASTES

Product	BOD, ppm	Suspended solids, ppm
Pulp		
Groundwood	645	
Soda	110	1720
Sulfate (kraft)	123	
Sulfite	443	
Miscellaneous paper		
No bleach	19	452
With bleach	24	156
Paperboard	121	660
Strawboard	965	1790
Deinking used paper	300	

TABLE 23-4

CHARACTERISTICS OF KRAFT-MILL WASTES

Characteristic	Maximum	Minimum	Average
pH	9.5	7.6	8.2
Total alkalinity, ppm	300	100	175
Phenol alkalinity, ppm	50	0	0
Total solids, ppm	2000	800	1200
Volatile solids, %	75	60	65
Total suspended solids, ppm	300	75	150
Volatile solids, %	90	80	85
BOD, 5-day, ppm	350	100	175
Color, ppm	500	100	250

TABLE 23-5

RELATIONSHIP OF MAJOR COMPONENTS OF SULFITE WASTE LIQUOR [264]

Component	% Total solids, bone-dry basis
Lignin	51.6
Sugars	16.9
Sulfur	9.15
Calcium	4.5

Abstract (continued)

TABLE 23-8

SOLIDS AND BOD ANALYSIS OF SEMICHEMICAL SODA-PULPING WASTE [266]

Component	Percentage attributable to each component	
	Total solids, %	BOD, %
Pentosans	5.7	18.9
$NaHCO_3$	11.5	0.0
$NaC_2H_3O_2$	26.1	56.7
Sodium formate	6.8	4.2
Lignin	14.9	*
Hydrolyzable fraction of suspended solids other than pentosans	5.4	*
Total	70.4	79.2

* Doubtful 5-day BOD value.

TABLE 23-12

BREAKDOWN OF JUTE, ROPE, AND RAG COOKING-LIQUOR SOLIDS SOLUBLE IN COLD WATER [280]

Type of cook waste	Total solids in cold water, ppm	Volatile matter, %	Components of volatile matter in cold water, as % of volatile matter					
			CO_2	Grease	Lignin	Volatile acids, as HAC	Complex polysaccharides	Protein, total N × 6.25
Jute	5.540	68.8	30.0	0	21.8	40.9	10.9	4.5
Rope	37,000	54.3	25.4	0	39.4	14.8	10.6	6.4
Rag	85,800	58.4	24.6	7.6	24.3	10.4	3.6	3.8

TABLE 23-14

ANALYSES OF BY-PRODUCT COKE-PLANT WASTES [1]

Characteristic	Ammonia-still wastes	Final-cooler wastes*	Pure-still wastes	Combined wastes
BOD, 5-day, 20°C	3974	218	647	53–125†
Total suspended solids, ppm	356		125	89‡
Volatile suspended solids, ppm	153		97	
Organic and NH_3-N, ppm	281	14	20	
NH_3-N, ppm	187		10	
Phenol, ppm	2057	105	72	6.4§
Cyanide, ppm	110			
pH	8.9		6.6	

* No recirculation.
† Depending on compositing technique.
‡ Average of 11 daily 24-hour composites, including coke breeze.
§ Single-catch sample.

Abstract (continued)

TABLE 23–20

PLATING-WASTE CONCENTRATIONS [218]

Plant	pH	Cu, ppm	Fe, ppm	Ni, ppm	Zn, ppm	Chromium, ppm		Cn, ppm
						+6	Total	
A	3.2	16	11	0	0	0	1.0	6
A	10.4	19	3	0	0	0	0.5	14
B	4.1	58	1.2	0	0	204	246	0.2
C	2.8	11		0.2		3	7	1.2
D	2.0	300	10	0	82	0	0	0.7
E	2.4	35	8			555	612	1.2
E	10.7	14	4	19		32	39	2.0
F	10.5	6	2	25	39			10
G	11.3	18	18	26		36		15
G	11.9	23	21	32		95		13

TABLE 23–24

MINERAL ANALYSES OF OIL-FIELD BRINE SAMPLES [69]

Radical	Concentration range, ppm
Calcium	1,507–12,888
Magnesium	346–4,290
Sodium	8,260–63,275
Bromide	32–633
Carbonate	0
Bicarbonate	43–644
Sulfate	0–1,578
Chloride	12,750–127,220
Total solids	25,210–248,600

Abstract (continued)

OIL REFINERY WASTE: CLASSIFICATION OF SUBSTANCES FOUND IN WASTES FROM THE OIL REFINERY INDUSTRY AS PREPARED BY THE AMERICAN PETROLEUM INSTITUTE*

Refinery unit	Native solutes and those present in end products	Solutes present which result from chemical reactions	Naturally occurring emulsoids and suspensoids, and those persisting in end products	Suspensoids and emulsoids resulting from chemical and physical actions
1. Oil storage	(*a*) Organic sulfur compounds† (*b*) Acids: H_2S, CO_2, organic acids (*c*) Inorganic salt: NaCl, $MgCl_2$, Fe and Al compounds, $CaCl_2$ $(NH_4)_2S$, etc.		(*a*) Suspended matter in tank bottoms. (*b*) Insoluble salts, SiO_2, $Al_2(SiO_3)_3$, S, finely divided substances. (*c*) Asphaltic compounds (in some cases).	
2. Distillation:				
A. Straight distillation	(*a*) Organic nitrogen compounds‡	(*a*) Inorganic salts, sulfites, acid sulfites, Na_2CO_2, $(NH_4)_2S$, Na_2S, Sulfates, acid sulfates.	Insoluble organic and inorganic salts, S compounds, sulfonic and naphthenic acids, and insoluble mercaptides.	(*a*) Oil-water emulsions from steam in towers, etc.
	(*b*) organic sulfur compounds†	(*b*) Acids and alkalies: H_2S, NaOH, NH_4OH, $Ca(OH)_2$.		(*b*) Soaps.
	(*c*) Phenol and like compounds	(*c*) $(NH_4)_2SO_4$, $(NH_4)_2S$, NH_4Cl		(*c*) Waxy emulsions.
	(*d*) Naphthenic acids			(*d*) Oxides of metals.
B. Cracking and distillation	Same as 2–A	Same as 2–A with the addition of phenols and phenolic compounds.	(*a*) Suspended coke	Same as 2–A.
			(*b*) Insoluble salts, FeS, and SiO_2	
3. Treating:				
A. Sweetening, sulfuric acid, neutralization.	(*a*) Organic sulfur compounds†	(*a*) Organic sulfur compounds	(*a*) Suspended matter: Pbs, S, S compounds.	(*a*) Waxy emulsions.
	(*b*) Organic nitrogen compounds‡	(*b*) Phenolic and sulfonate compounds.	(*b*) Acid and alkaline sludges	(*b*) Oil-water emulsions.
	(*c*) Naphthenic acids	(*c*) Weak H_2SO_4 and other acid solutions.	(*c*) Polymers and resins	(*c*) Inorganic salts: PbS, $CaSO_4$, $CaHPO_4$.
	(*d*) Phenylates	(*d*) Weak alkaline solutions.		(*d*) Soaps.
		(*e*) Soaps		(*e*) Oxides: PhO, Fe_2O_2.
		(*f*) Inorganic salts: $CaCl_2$, Na_2CO_3, Na_2SO_4, NaCl.		
		(*g*) Oxides dissolved in alkaline solutions as PbO, CuO, etc.		
B. Clay	Same as 3–A	Same as 3–A, (*a*), (*b*), (*c*), and (*f*)	(*a*) Suspended clay, earth	(*a*) Suspended clay, earth.
			(*b*) Polymers and resins	(*b*) SiO_2, H_2SiO_3, $Al(OH)_3$.
4. Recovery:				
A. Gas purification and recovery.	(*a*) Organic sulfur compounds†	(*a*) Inorganic salts: sulfates, acid sulfates, sulfites, acid sulfites, FeS, $(NH_4)_2S$, Na_2CO_3, Na_2S.	Insoluble S compounds and mercaptides.	Suspended Fe and S compounds.
	(*b*) Organic nitrogen compounds‡	(*b*) Mercaptides		

Abstract (continued)

Refinery unit	Native solutes and those present in end products	Solutes present which result from chemical reactions	Naturally occurring emulsoids and suspensoids, and those persisting in end products	Suspensoids and emulsoids resulting from chemical and physical actions
B. Acid recovery	(*a*) Sulfonates (*b*) Mineral acids (*c*) Organic nitrogen compounds[‡]	(*a*) Inorganic salts, and H^3SO_4, SO_2, SO_3 (*b*) Organic esters	(*a*) Organic suspensoids: tars (*b*) Some sulfur compounds[§] (*c*) Some nitrogen compounds[**]	Acid sludges.
5. Miscellaneous:				
A. Cooling and boiler water treating.		Inorganic salts: $BaCl_2$, NaCl, $NaHCO_3$, Na_2SiO_3, $CaCl_2$, $MgCl_3$, Na_2CO_3, Na_2SO_4, Na_2HPO_4, $CaHPO_4$, etc.		Insoluble and colloidal compounds: $CaCO_3$, $BaCO_3$, $Ca(OH)_2$, $Mg(OH)_2$, $Ba(OH)_2$, $Ca_3(PO_4)_2$.
B. Fire protection		(*a*) Inorganic salts: $NaHCO_3$, Na_2SO_4, $Al_2(SO_4)_3$. (*b*) Organic compounds		

[*] Asphalt and lubricating-oil units have not been included in the separate headings. Straight-run distillation involves the heavier oils, also sulfuric-acid treating embraces that of lubricating oils as well as light oils.

[†] Under this caption are included mercaptans, dialkyl sulfides, sulfonates, sulfonic acids, some alkyl and aryl sulfides, etc. Only a few of these compounds will be found in any one type of oil.

[‡] Under this caption are included: amines, some amides, quinolines, and pyridines. Only a few of these compounds will be found in any one type of oil.

[§] Some alkyl sulfides, thiophenes, etc. Not all of these compounds are found in any one given type of oil.

[**] Quinolines, some amides, pyridines, and some aryl amines. Not all of these compounds are found in any one given type of oil.

TABLE 23-26

CHARACTERISTICS OF TYPICAL REFINERY WASTES (AFTER WESTON [112])

Column number	1	2	3	4	5	6	7	8	9
Type waste	Water layer	Water layer	Milk water emulsion	Emulsion	Emulsion	Emulsion	Condensate	Condensate	Condensate
Source of waste	Slop oil treatment	Slop oil treatment	Water wash	Bar condenser	Jet vacuum pump	Desalting	Low sulfur gas separator	Vis. breaker gas separator	
Type unit	Spent caustic and heat, plant scale	Vacuum precoat filter, pilot scale	Treating	Combination unit	Lube oil vacuum still	Desalting unit	Combination unit	Combination unit	Light oil recovery
Quantity of waste			1 bbl/bbl product						
Acidity, ppm									
Alkalinity, ppm			15,313	59.5	520	739	1518	2963	69-13,175
Ammonia, ppm				4.1	225	2.0	500	130-999	3-8,350
BOD, ppm	5,660-14,440	77-153	7,900		425	404	408	3040	55-9,500
COD, ppm	22,000-56,000	500-1360	86,775	72.3		865-3031	1201	7239	214-16,255
Odor threshold				1.0		1.8	2.5	4.5	3.5
Oil, ppm	4,900-10,300	37-130	31,600	236	94.3	32-713	3	2.5	6-230
pH	10-10.2	6.9-7.7	9.79	7.22	7.03	9.26	8.5	7.85	5.0-9.2
Phenol, ppm				2.3		4.1	0.06	156	0-213
Sulfide, ppm				1.3			600	1500	T-5,000
Suspended solids ppm	60-940	30-139							
TLM, 24 hr									14

[*] Approximate 24-hour median tolerance limit for bluegill sunfish, expressed as per cent concentration of waste.

Abstract (continued)

Column number	10	11	12	13	14	15	16	17	18	19
Type waste	Acid	Acid	Spent caustic	Spent caustic	Spent caustic	Carbolate	Alkaline	Special chemicals	Special chemicals	Refinery Separator inlet
Source of waste	Unit sewer	Unit sewer	Alkylate wash		Naphtha wash	Naphtha wash	Shut-down	Unit sewer	Unit sewer	
Type unit	Alkylation unit	H_2SO_4 sludge conversion unit	Chemical mfg.	Catalytic polymerization	Treating	Fluid catalytic cracking unit	Caustic methanol sweetening	Alkylation sulfonation	Detergent drying	See Note†
Quantity of waste			0.21 lb NaOH used per lb product	0.8 lb NaOH used per bbl product						9.6 mgd
Acidity, ppm	1,105-12,325	1,140-10,050						18-245		0-188
Alkalinity, ppm			46,250	209,330	80,020	247,900			150	0-92
Ammonia, ppm	1.2	2-13						1.8	0.2-12.6	
BOD, ppm	31	10-272	256	8,410	51,151	363,600		28-151	8-1,180	96-501
COD, ppm	1,251	910	3,230	50,350	141,120	901,200	371-290,000	259-5382	2,585-51,350	
Odor threshold	3.7	3-5	1.5					1.2		3.25-5.32
Oil, ppm	131.5	124	10	T-12			8-58	13-1310	40-7,750	3900-6500
pH	0.6-1.9	1.71	12.8	12.9	13.4	13+	9.5-12.5	4.6	7.37-9.31	2.4-6.2
Phenol, ppm			50	22.2	23,312	309,300		0-7.4		0.5-7.9
Sulfide, ppm			2	3,060		0-3,380				
Suspended solids, ppm			253	51-279		678				131-678
TLM, 24 hr†	0.4	3			0.01					33

† Waste represents combined discharges from a complete refinery, with the exception of naphtha-treating wastes.

TABLE 24-2

PHOSPHORUS WASTES [10]

Characteristic	Amount or value
pH	1.5-2.0
Temperature	120-150°F
Elemental phosphorus	400-2500 ppm
Total suspended solids	1000-5000 ppm
Fluorine	500-2000 ppm
Silica	300-700 ppm
P_2O_5	600-900 ppm
Reducing substances as (I_2)	40-50 ppm
Ionic charge	Predominantly positive (+)

Abstract (continued)

TABLE 24-3

BIOCHEMICAL OXIDATION OF THE PRINCIPAL DETERGENT TYPES (AFTER BOGAN [2])

Synthetic detergent, class and type	5-day 20°C BOD				BOD, Warburg method	
	Sewage seed		Acclimated seed		Acclimated seed	
	ppm × 10^3	% of theor.*	ppm × 10^3	% of theor.*	ppm × 10^3	% of theor.*
Anionic						
Akyl benzene sulfonate						
n-dodecyl	237	10.0	1046	44.2	300	12.7
Keryl	0	0	535	21.6	240	10.1
Tetrapropene	0	0	81	3.4	40	1.7
Alkyl sulfate						
n-dodecyl	1307	57.2	1362	59.7	930	40.7
Dupanol C	1250	4.8	1330	57.4	920	45.2
Sulfonated ester						
Igepon AP-78	1315	59.8	1460	66.5	990	45.0
Sulfonated amide						
Igepon T-77	1443	52.0	1558	56.0	1560	56.0
Nonionic						
Alkyl phenoxy polyoxyethylene						
Neutronyx 600	0	0	116	5.4	254	11.8
Igepal CA 630	132	6.1	124	5.7	440	20.4
Rohm and Hass						
OPE-5	310	13.1	390	16.4	170	7.2
Polyethoxy amide						
Ethomid HT/15	996	47.5	880	42.0	412	19.5
Ethomid HT/60	29	1.5	310	15.9	16	8.2
Polyethoxy ester						
Ethofat C/15	1000	46.5	880	42.0	640	29.1
Ethofat C/60	220	11.8	240	12.8	160	8.5
Polyglycol ethers						
Pluronic F68	124	6.0	20	1.1	67	3.6

* Based on theoretical amount of oxygen required for complete conversion to CO_2 and H_2O.

Disease/Solid Waste
Abstracts

No. DSW- 252

Author

Joseph M. Culotta

Title

Treatment of Cyanide and Chromic Acid Plating Wastes

Reference

Plating, June 1965, pp. 545

Doc. No.	Contract No.	Date issued

Abstract

Evaporative methods for treating cyanide and chromic acid plating wastes are described. Plating chemicals are recovered from overflow from rinse tanks by evaporative concentration of the solution. Concentrated solution is returned to plating bath for reuse; distilled water is recirculated to the rinse tanks. Economic advantages of the techniques are cited. A basic closed loop system is described, followed by a discussion of partial recovery methods, in which a minor part of the dragout overflow is treated by other than evaporative methods. An optimized system for recovering and purifying chromic acid plating waste by evaporation and ion exchange, while utilizing waste heat to effect evaporation, is also covered.

Descriptors

closed loop system
ion exchange
sewage
reuse
plating
evaporation
waste

Disease/Solid Waste Abstracts

No. DSW-253

Author

Samuel A. Greeley

Title

Criteria for Municipal Incinerators......

..The Designer's View

Reference

Mechanical Engineering, November, 1956

Doc. No.	**Contract No.**	**Date issued**
pp. 1024		

Abstract Kinds of Furnaces

Rectangular furnaces stoked manually or by oscillating or moving grates.
Round furnaces mechanically stoked
Furnaces with traveling grates
Furnaces with moving grates made of pallets or plates
Furnaces having grates or kilns

Particular definitions of refuse materials on the basis of laboratory analyses are rather limited in number. A relatively dry refuse might contain 20 percent of moisture, 20 percent of ash, and 60 percent of combustible matter. The combustible matter might contain the materials given in Table 2.

A refuse of the characteristics given in Table 2 would require theoretically 3.68 lb of air per lb of refuse for combustion. The gaseous products of combustion (exclusive of the ash) would amount to 6.32 lb of air per lb of refuse, with 50 percent of excess air.

The design of an incinerator comprises the following four principal parts:

(a) General aspects such as the quantity and character of refuse, the location of the plant, and the characteristics of the receiving airway. It is assumed that such general parts will have been covered by an adequate engineering investigation and report.

(b) General arrangements, such as the approaches, the yard, the scales, the storage bin, the building, the clearances within the building, the cranes, and the ash-removal facilities.

(c) The part which comprises the furnaces and their appurtenances with bases of design for grate areas, volumes, dampers, flues, and of subsidence (or expansion) chambers, for the removal of fly ash or particulate mater. This part constitutes the

Descriptors

furnaces
burning rates
particulate matter
electrostatic precipitators
refuse
rubbish
pollution
scrubber
fly ash
air-pollution
centrifugal precipitators
criteria

Abstract (continued)

structures and the equipment which have to do with combustion.

(d) The chimney.

The first matter of importance in determining bases of design is the kind of refuse to be incinerated.

The second matter to consider comprises the capacity, the size, and the shape of the furnace.

Size-Refuse-incinerator furnaces have been built with rated capacities of 250 tons per 24 hr as in New York City, using moving geates. A more usual range is 100 to 150 tons.

Burning Rate-Until recently a considerable number of refuse incinerators have been designed to operate at burning rates in excess of 70 lb per sq ft of horizontal grate area per hr. These nigh rates of burning are considered to increase the quantity of particulate matter and other air pollutants. Lower burning rates are now considered to contribute to the control of the pollution of the receiving airways. A recent design for Evanston, Ill, has a burning rate of 53.5 lb per sq ft per hr for mixed garbage and rubbish.

Depth of Furnace-Distances from the inside front wall to the rear wall or the diameter of a number of existing incinerators are given in Table 4. To facilitate stoking, an inside depth of not over about 10 ft is indicated.

Volumes-Table 4 shows the unit volume in cubic feet per ton of rated capacity of furnaces, combustion chambers, and subsidence chambers for a number of plants. They will depend considerably upon the characteristics of the refuse and should be larger for rubbish than for mixed refuse. For mixed refuse a furnace volume of 12.5 and for rubbish of 20.0 cu ft per ton seems to be reasonable.

To meet air-pollution requirements, combustion and subsidence chambers, particularly the latter, have been increased greatly in unit volume of recent years. A volume in these two structures of around 80 cu ft per ton is indicated.

Flues-The area of flues is usually determined on the basis of limiting velocities in feet per second. For the flue between the furnace and the combustion chamber, a relatively high velocity of 35 fps or more is indicated to provide mixing and of other flues of 25 fps.

A considerable number of municipal ordinances are in effect relative to this matter and most of them have taken either one or the other of the following forms:

(a) The weight of particulate matter per 1000 lb of gas with 50 percent excess air; the usual limiting value being 0.85 lb as established in the ASME model code.

(b) The weight of particulate matter per cubic foot of gas at standard conditions. The standard set up by the L. A. County Air Pollution Control District is 0.40 grain per cu ft of gas at 60F, 14.7 psia, and 12 percent CO_2.

None of the ordinances so far has undertaken to specify the amounts of other substances in the gaseous products of combustion which may be tolerable in regard to air pollution, such as the oxides of nitrogen and sulphur. The two standards to which reference is made permit the amounts of particulate matter in chimney discharge given in Table 5.

A rational or realistic yardstick for regulating the discharge from incinerator chimneys is much to be desired. Such a yardstick might limit the content of particular matter in the gases entering the airways to a certain number of pounds

Abstract (continued)

per ton of refuse burned. Present available experience suggests a limit of 10 lb per ton, but many more data are needed before a final determination. Yardsticks for other pollutants such as nitrogen and sulphur may be needed in some locations.

While little is known regarding the quantity of particulate matter in the raw gases, the amount is illustrated by the units of 15 lb per ton of mixed refuse and 20 lb per ton of rubbish. On this assumption, equipment to remove fly ash or particulate matter should have an efficiency based on the raw gases of upward of 50 percent. To permit the establishment of more accurate and realistic bases of design, the author considers that full-scale tests are desirable to determine the efficiency of existing fly-ash facilities of different kinds.

Many bases of design of municipal refuse incinerators are now scrutinized in the light of their effect on the recuction of the pollution of the receiving air. On this account, three general factors are important:

(a) A reduction in the quantity of under-fire air.

(b) An avoidance of too frequent disturbance of the fire by charging refuse onto the grate.

(c) A lower burning rate.

Specific yardsticks or procedures in relation to the foregoing are not, as yet, fully developed.

In a study of air-pollution-control facilities, three very general characteristics should be kept in mind, as follows:

(d) Facilities which can be used with hot gases of combustion.

(e) Facilities requiring cooled gases of combustion.

(f) Facilities using water.

Various devices for removing particulate matter from the gaseous products of combustion are illustrated as follows:

(g) Subsidence chambers with various kinds of trapping and impingement walls and corners. This device is applicable to hot gases and is extensively used.

(h) Subsidence chambers with water sprays and a bath as installed at Milwaukee, Miami, Philadelphia, and, without a water bath, at a number of rubbish incinerators in the Los Angeles area.

(i) Cyclone or centrifugal precipitators made in different forms by a number of manufacturers. All require the gases to be cooled to about 700 F. Few have been installed in refuse incinerators.

(j) Bag filters made of steel or glass mesh. These require the gases to be cooled. In so far as the author knows, none has been installed in refuse incinerators.

(k) Electrostatic precipitators which are used in power plants on gases cooled by passing through a boiler. In so far as the author knows, none has been installed in refuse incinerators.

(l) The municipal refuse incinerator at Framingham, Mass., is equipped with a scrubber for the gaseous products of combustion.

Abstract (continued)

Table 3 Differences Between Types of Refuse

Item	Kind of refuse Rubbish	 Mixed[a]
Per cent moisture	15	54
Pounds of air per pound of refuse for:		
Combustion plus 50 per cent excess	5.85	3.18
Cooling to 1600 F	4.04	0
Total	9.89	3.18
Gaseous products of combustion in cubic feet per pound of refuse at 1600 F	554	211

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[a] 65 per cent garbage at 75 per cent moisture and 35 per cent rubbish at 15 per cent moisture.

Disease/Solid Waste Abstracts

No. DSW-254

Author

No author given

Title

Metal Finishing Wastes

Reference

Metal Progress, May 1963, V. 83, No. 5,

Doc. No.	Contract No.	Date issued
pp. 157		

Abstract

Very small amounts of some ions affect the sludge digestion process. For example, mercury at 0.01 ppm, copper at 1 ppm, cyanide at 1 to 2 ppm, chromium and nickel at 2 ppm and zinc at 5 ppm inteferer with the bacterial action of the digester. Deceleration of bacterial digestion caused by heavy metal ions leads to an increase in the concentration of the organic acids constituting the intermediate breakdown products of the sludge. Unless lime is added to speed up the digestion process, the biological digestion rate falls far below normal, and metals will be dissolved by the organic acids. When dissolved, they kill the bacteria, and a new colony must then be grown.

Wet sludge containing 2000 ppm (or more) of heavy metals is not uncommon, and digested solids frequently contain more than 5000 ppm. This concentration of metallic impurities reduces the value of the dry sludge as fertilizer, since such impurities might harm soil fertility.

Since highly concentrated neutral solutions of sulfates corrode concrete, metal finishing wastes containing sulfates must be diluted before discharge. In the absence of these precautions, sewer systems have been damaged in a few weeks, requiring costly repairs.

Oil emulsions in plant waste usually are broken in sewer systems, producing scums coating sewer walls. This scum picks up solids such as scale and abrasive particles and results in clogging, gradually restricting flow.

Mineral oil, solvents and paints can result in a hazardous condition. To prevent explosions in sewers, such waste must be kept out of the sewer system.

Cyanide waste poses a health problem, fatalities having been ascribed to toxic hydrocyanic gas generated in the sewer system from the mixing of cyanide and acid wastes. Consequently, municipal ordinances in England restrict the maximum cyanide concentration to 10 ppm

Descriptors

metal finishing waste
cyanide
zinc
organic acids
dry sludge
sulfates
solvents
cyanide waste
toxic hydrocyanic gas
sludge digestion
chromium
bacterial action
lime
fertilizer
scums
paints
health problem
mercury
nickel
digester
bacteria
soil fertility
mineral oils
explosions
fatalities

Disease/Solid Waste Abstracts

No. DSW- 255

Author

No author given

Title

High-Temperature Combustion of Chemical Residues Solves Pollution Problem

Reference J. of the Amer. Soc. of Lubrication Engineering, V. 21, No. 10

Doc. No.	**Contract No.**	**Date issued**
Oct. 1964, p. 371		

Abstract

The search for a way to dispose of the chemical resudies from the production of materials such as plastics, insecticies, and refrigerants has been one of industrys longest and costliest projects. The simple answer may well lie in a combustion and absorption system being marketed by the Carbon Products Division of Union Carbide Corp., under an exclusive license from Hooker Chemical Corp.

Chlorinated and fluorinated hydrocarbons are the worst of the bad actors. Not only are many of them hazardous, but their organic structure cannot be broken down by bacterial action - it is nonbiodegradable, as the chemists say - and leads to pollution of the streams into which it finds its way.

Two methods of getting rid of hydrocarbons, both chlorinated and fluorinated, have traditionally been used; 1) they have been fed into settling ponds, or 2) they have been buried in steel drums. The first technique requires a considerable investment in land, and still runs the risk of stream pollution and ground water contamination. The second method entails obvious expense, and if the drums eventually rust awa, ground water contamination could again result. Conventional burning of many of these residues is not possible because they will not support combustion at ordinary temperatures.

Now, after four years in operation, a feasible residue disposal system has been developed for processing residues with a chlorine content as high as 90 percent. The two-part system includes a high-temperature combustion chamber and an absorption system that can be designed to recover commercial strength halogen acids.

The reaction chamber is actually a giant heat interchanger consisting of an inner downdraft chimney and a covered outer shell, the combustion reaction taking place near the top of the inner chimney. Because the combustion of chlorinated hydrocarbons in the reactor takes place at from 1650 to 2370 degrees F., auxiliary

Descriptors

chemical residues
combustion
pollution
stream pollution
disposal
costs
plastics
absorption
settling ponds
ground water contamination
chlorine
insecticides
hydrocarbons
buried
burning
heat interchanger

Abstract (continued)

fuel is used for start-up. Once the inner wall reaches operating temperature, no further fuel is required. Residues enter the hot reaction zone and liberate large quantities of heat upon burning, maintaining the temperature of the chimney. Thermal equilibrium is attained by using this heat to preheat combustion air flow upward in the annulus between the shell and internal chimney, down through which the hot gases are being discharged. It is this interchange of heat eliminating the need for auxiliary fuel, that makes the process economical. Special refractories, carefully selected for the applicatio, are used to line the combustion chamber and to form the inner tube or chimney.

When the residues burn, the only by-products formed are water, nitrogen, oxygen, carbon dioxide, and gaseous HCl. No chlorine, carbon monoxide, or hydrogen are discharged from the reactor.

The gases leave the residue reactor at approximately 1600 degrees F. and are cooled adiabatically in a carbon tower spray chamber. They are then scrubbed in a packed carbon tower. Nitrogen, carbon dioxide, and oxygen are vented to the air and the extremely dilute acid - usually approximately 1 percent - can be discharged. Depending on the residue being disposed of, and the economics of the process, the absorber can be designed for the recovery of commercial halogen acids.

Residue disposal systems operated to date have had burners ranging in internal volume from 76 to 1500 cubic feet, but the process itself imposes no practical size limitations. Operating costs per callon of 70 percent halogenated residue disposed have been found to be approximately half those of drum disposal. It is estimated that the total installed cost of a complete system with a 1,000 cubic-foot burner, which would be rated at from 4 to 7 gallons per minute or residue, would be approximately $250,000. At an operating rate of 2 million gallons a year, such a plant would dispose of 8 gallons of residue per year per dollar of installed system cost.

Disease/Solid Waste
Abstracts

No. DSW- 256

Author

C. C. Porter & Fred W. Bishop

Title

Treatment of Paper Mill Wastes in

Biochemical Oxidation Ponds

Reference

Industrial & Eng. Chemistry, V. 42, No. 1

Doc. No. **Contract No.** **Date issued**

Jan. 1950, pp. 102

Abstract

A typical kraft mill waste contains primarily sodium lignate, sodium resinate, and complex organo-sulfur compounds, and some fiber in relatively dilute solutions.

As one of the large contriburors to the BOD load of the total mill effluent was cellulosic fiber, considerable storage work was performed by the Engineering Experiment Station of the Agricultural and Mechanical College of Texas using the bacteria from a cow's stomach as a seeding material. The results were good, but they failed to show sufficient improvement over straight storage to warrant further study.

Full scale operation of the large impounding reservoirs was started in the late spring of 1946. They fulfilled all of the physical design specifications in regard to capacity and operating principles. After the ponds were in operation for a few weeks the results indicated that the desired benefits might be expected. A typical pattern of BOD reduction on the total mill effluent from the mill to the river may be listed as follows: mil outfall, 200 ppm; effluent from the first pond 160 ppm; effluent from the second pond, 120 ppm; effluent at the river, 90 ppm. With the reservoirs in operation and with the river flow at 400 cubic feet per second, the dissolved oxygen at the sag point in the river was 4.1 ppm. In the year before at this river flow, only a slight trace of oxygen was found at this point. The sag point, as mentioned above, had been established earlier as the place at which the dissolved oxygen content would be lowest as the result of introduction of wastes.

The river flow continued to drop until it reached a low of only 55 cubic feet per second, and the dissolved oxygen at the sampling point was 3.4. At this flow the ratio of river water to reservoir effluent was 4.5 to 1. During the months of August and September, the average temperature of the atmosphere and the impounded waste was 89°F. At a time like this the bacterial activity was apparently accelerated to the extent that the BOD reduction was as follows: total mill effluent, 200 ppm; first pond effluent, 120 ppm.; second pond effluent, 90 ppm; effluent at the

Descriptors

paper mill wastes
kraft mill waste
BOD
sludge

biochemical oxidation ponds
sodium resinate
cellulosic fiber

sodium lignate
bacteria

Abstract (continued)

river, 35 ppm.

During 2 years of operation a very large accumulation of suspended material settled in the upper reaches of the first pond. In operation much of this material in the process of decomposition floated to the top and covered as much as two thirds of the surface. The material was shifted from one end of the pond to the other according to wind direction, but apparently it did not impose too much additional load in the liquid effluent from this pond. It was readily apparent that over a period of years the sludge and its subsequent removal would prove a tremendous problem.

Between the mill and the first pond a pre-sedimentation pond was built with smooth sloping sides to facilitate easy removal of the deposited sludge. This basin was built with the intention of a complete cleaning program each year during the winter months. This would be accomplished by the use of a dragline to move the material above the water line, or by using a bulldozer and pushing the material from the basin.

The use of oxidation lagoons is not presented as a cure-all for kraft or newsprint effluents, but rather as an abatement procedure which may be utilized when all of the conditions are favorable.

Disease/Solid Waste Abstracts

No. DSW-257

Author

John Winton

Title

The Detergent Revolution

Reference

Chemical Week, May 30, 1964, pp. 111

Doc. No. **Contract No.** **Date issued**

Abstract

Formulators are switching over to straight-chain surfactants in the hope that they will solve most of the problems caused by the slow biodegradability of conventional branched-chain materials. The change, they also hope, will avoid restrictive legislation now pending in Washington.

But there's frank concern that the improvements offered by linear alkylate sulfonate (LAS) and linear alkylphenols (LAP) will not be sufficient. The deepest doubts concern the adequacy of LAP biodegradability. But LAS too could be swept off the stage if it fails to quell detergent pollution problems.

Significance of detergents role in water pollution is not well defined. But the villain of the drama is branched-chain alkylbenzene sulfonate (ABS).

...Increasing reuse of water in parched areas of the country has raised fears that ABS would build up beyond concentrations regarded as safe....

Crux of the problem is the slow rate at which ABS is broken down by bacteria to carbon dioxide, water and simple organic substances. Efficient secondary-treatment sewage plants degreade only 40-60% of influent ABS. Replacing the branched carbon chains of ABS (and alkylphenols) with straight chains greatly improves biodegradability. Under favorable conditions, sewage treatment will degrade more than 90% of influent LAS.

Under anaerobic conditions biodegradability of LAS is not appreciably better than that of ABS. And at least one-third of the U.S. population discharges sewage to essentially anaerobic cesspools and septic tanks. Under unfavorable soil conditions (e.g., on Long Island, in Minneapolis and elsewhere) ABS "leaks" into groundwater.

Sewage of an additional one-third of the population is handled by primary plants only or discharged directly to waterways. Although LAS will produce an improvement in these cases, there are questions as to whether the extent and rate

Descriptors

detergent
surfactants
linear alkylate sulfonate (LAS)
linear alkylphenols
biodegradability
pollution
alkylbenzene sulfonate (ABS)
bacteria
sewage treatment
anaerobic
cesspools
septic tanks
groundwater
foam
long-chain linear alcohols
aerobic
precipitation

precipitation
detergent alcohols
Lauryl sulfate
phosphate
silicates
carboxymethylcellulose salts
syndets
contamination
corrosive substances
safety
disposal
reuse
health
toxicity
bacteria
soft detergents
sedimentation

irrigation water
coliform
sedimentation
solids

Abstract (Continued)

of LAS biodegradability will be sufficient to eliminate foam problems.

And even where secondary sewage treatment is concerned, a total cure is not certain. Variation in operating conditions of secondary sewage plants can reduce the 95-98% biodegradability theoretically attainable with LAS (see pp. 123-126).

Upshot: no one knows whether the so-called "soft" LAS suractants will solve 90%, 50% or even less of the national problem posed by detergent pollution.

Long-chain linear alcohols loom as the most likely candidates for the "third generation" surfactants if linear alkylphenol or alkylate fails to prove out from a biodegradability standpoints. There's a feeling--strong in some quarters but discounted in others--that linear alkylate may have only a five-10-year lifespan.

Branched -chain alkylphenol ethozylate surfactants degrade slowly and incompletely under aerobic conditions. Biodegradability is improved when the branched chain is replaced with a straight chain.

Recent studies by Jefferson point up the problem. Branched-chain alkylphenol ethoxylate degraded* only about 9% in one study, while a comparable 9-10 mole linear alkylphenol ethoxylate degraded about 63%. Ziegler ethoxylates degraded about 100% in the same test. And Carbide found fast degradability for its secondary ethoxylates, as measured by river die-away experiments. General Aniline researchers report that linear alkylphenol ethoxylates are only moderately less degradable than linear alkyl sulfonates. They believe that if LAS proves acceptable, so will LAP. Complicating the picture: speculation that partial degradability of the ethoxy side chain will render the residue insoluble in water--hence, precipitation would eliminate the problem of biodegradability.

Detergent Alcohols: Most speculation about "third generation" detergents gocuses on detergent alcohols having chains ranging from 10 and 11 carbon atoms to 16-18 carbon atoms. Detergent alcohols may get the nod if surfactants that biograde ultra-rapidly are required to solve pollution problems. Lauryl sulfate, for example, degrades in a matter of hours to a point that takes linear alkysulfonate several days to reach.** And there's hope that ethoxylated alcohols will adequately degrade under anaerobic conditions. Biodegradation of alcohol sulfates under anaerobic conditons has not yet been fully established.

Builders: Phosphate, silicates and carboxymethylcellulose salts are the most important chemicals added to detergents to improve detergency, prevent redeposition of soil, etc. Sodium tripolyphosphate is the biggest tonnage item; about 90% of the total production (now about 800,000 short tons) goes into syndets. Second largest detergent phosphate is tetrabasic sodium pyrophosphate. Production in '63 totaled 110,000 short tons.

Detergent Problems: Foam formation is the earmark of the detergent degradability probelm "Hard" detergents are only partly destroyed in sewage treatment plants, eventually foam up in surface water and tap water.

Foam is blamed for reducing efficiency of sewage plants, necessitating costly chemical or mechanical means of ofam control. Power companies complain of foam in their evaporated makeup water. Foam from sewage plants and irrigation ditches is blown by winds, is said to carry contamination and corrosive substances.

*Shake-flask, colorimetric measurement

**Under acclimated conditions

Abstract (Continued)

Where there's foam, there usually is branched-chain alkylbenzene sulfonate (ABS). Questions have been raised about the safety of ingesting ABS and, for this reason, the U.S. Geological Survey is concerned about possible long-term ABS buildup in groundwater. It feels that detergent removal is all but impossible once groundwater is contaminated. The Federal Housing Administration has been known to reject housing loans on property with heavy ABS contamination. Moverover, there's some evidence that ABS reduces the rate of oxygen transfer from air to surface water--posing possible but yet unproved hazards to aquatic life.

The most serious ABS contamination problems occur in four areas: New York's Long Island, southern Florida, southern California, and the eastern Minnesota-Wisconsin-upper Michigan region. Lack of suitable sewage disposal (e.g., wells and septic tansk in close proximaity) is at the root of the problem in all but the southern California area, says Charles Bueltman, technical director of The Soap and Detergent Assn. Reuse of treated sewage water is the problem in southern California

Industry spokesmen consider foam to be primarily an esthetic nuisance and the problem strictly one of public relations. They say that foam has given the industry a black eye and has sullied the image of detergents as a cleanliness product--particularly when tap-water foam serves to indicate pollution by sewage. They feel that if it were not for foam, the industry would not have been obliged to take steps against ABS. And they point out that detergents are only one cause of foam, that other synthetic and natural surfactants contribute to the over-all foam problem.

Industry spokesmen assert that there is little danger of ABS buildup in water supplies, cite the unchanging ABS levels in the Ohio River as evidence. And available data indicate no hazard to health from drinking water contain ABS in present concentrations. Long-term (10-20 year) studies of the toxicity of ingesting small quantities of ABS, however, have yet to be made.

The U.S. Public Health Service has set the maximum permissible level of ABS in drinking water at 0.5 ppm. This is believed to provide a 15,000-fold safety factor. Anionic surfactant concentrations in drinking water are generally well below that mark, although some well waters have registered 2.6 ppm. and river water supplies have reached 5 ppm. in exceptional cases. ABS concentration in sewage averages 7-10 ppm; effluents from efficient sewage plants show 40-60% lower ABS content. ABS concentrations as low as 1-2 ppm. will cause foaming.

Biodegradability: Biodegradability, the bugaboo of detergent makers, is shrouded in mystery. Uncertainty ranges from the very definition to test methods and the effect of small amounts of detergents on taste and odor of drinking water. As a result, the adequacy of sewage disposal systems and the need for legislation is open to question.

In the present context, complete biodegradability refers to the capacity of a detergent to be broken down by bacteria into carbon dioxide, water and relatively simple organic molecules, in a process that bacteria use to make new protoplasm. Detergent makers like to think of it as "the ability of a given sewage treatment system to remove surfactants at least to the same extent as it removes normal sewage constituents."

The question of definition is important. The new straight-chain materials degrade under microbial attack to carbon dioxide and water, and relatively simple molecules incorporated by the bacteria into their protoplasm. But some of these

Abstract (Continued)

organic degradation products are not retained by the sewage bacteria and are discharged into sewage effluent. If legislators accept a rigoroug definition, the presence of these degradation products, even though they have no surface-active properties, would disqualify the new detergents from which they came.

The competitive position of LAS materials from different producers will be determined, in part, by their biodegradability--and that can be a function of the test employed. Special SDA committees are trying to agree on standard tests of anionic and nonionic sufactants.

Because of variations in test methods, observers differ--sometimes widely--on the degree of biodegradability of different soft detergents.

Groundwater Worry: Although there is little doubt that LAS readily degrades under aerobic conditions, there is a serious question concerning degradability under oxygen-deficient conditions, such as prevail in goundwater. The issue is significant: about 20% of the more than 300 billion gal./day of water consumed in the U.S. comes from groundwater sources; almost 100 million people are supplied from these sources; and groundwater is a significant factor in three of the four major ABS problem areas in the U.S. Many other regions also have detergent-contaminated water supplies that reduce property values.

Recent research suggests that oxygen-containing organics (alcoholates, sugar esters, etc.) may be appreciably biodegraded under relatively anaerobic conditons. But the same cannot be said with assurance about the more prominent detergent compounds.

A Denver-based team of Geological Survey researchers, headed by Cooper Wayman, research chemist, recently completed a study of Federal Housing Administration of the biodegradability of detergents in groundwater. Key conclusions:

(1) LAS does not degrade in significant amounts under anerobic conditions at temperatures between 10-35 C.

(2) Clay minerals do not adsorb appreciable amounts of ABS from waste water. Wayman believes that the same would be true of LAS.

(3) ABS is adsorbed under conditions of saturated flow through soils but ABS removal declines with increasing throughput.

(4) ABS concentration is incompletely but significantly reduced during infiltration of irrigation water through unsaturated, fine-grained soils. Aquifers deeply below (50-100 ft.) the surface would be infiltrated by ABS very slowly if "tight" soil conditions existed; but aquifers close to the surface (4-15 ft.) would be rapidly contaminated with ABS, especially if "coarse" soil conditions prevail.

(5) Little ABS removal takes place over relatively long distances of horizontal groundwater movement.

All the evidence is not yet in, but results to date indicate that there is little detectable degradation of either straight- or branched-chain ABS once the waste reaches groundwater.

Coliform Questions: In the Long Island tests large reductions in coliform bacteria population were discovered in household disposal and in downstream well systems as a result of the switch from detergent to soap. Flynn, as yet, has no explanation of the result. SDA can't explain it either. Some studies at Syracuse University indicate that soap promotes higher coliform counts in septic tank effluents than do hard or soft detergents.

Abstract (Continued)

Work by M. Starr Nichols, professor of sanitary engineering at the University of Wisconsin, suggests that ABS may promote migration of coliform through soil. The study showed that as the detergent concentration increased in shallow-well water, the percentage of unsafe wells increased. But laboratory tests at Taft failed to show that ABS rporoted migration of coliform bacteria.

Other Problems: The switchover to soft detergents may produce some problems of its own. British work (at Luton) suggests that soft detergents give rise to relatively larger amounts of foam during sewage works treatment although the effect does not persist in the effluent. (Colgate-sponsored tests with a trailer-park AS plant, however, showed appreciable foam reduction.) And some surfactant suppliers are concerned about use of soft surfactants in industrial plants that discharge large volumes of wastes to waterways. Their fear: soft surfactant "flooded" into a river may reduce water oxygen content to the danger point for aquatic life. Northwest paper mills reportedly had nondetergent problems of this type that necessitated conversion to less degradable chemicals used in processing.

Sewage Treatment: The detergent pollution problem is essentially one of sewage treatment. And the U.S. is grossly deficient in high-quality waste disposal. Combined primary and secondary treatment represents the most effective means of sewage disposal. Primary treatment is a sedimentation process that removes solids. Secondary treatment processes liquors from primary treatment of oxidized organics; 40-60% of hard detergent is removed in effective secondary treatment. Only 34% (see chart, p. 125) of the U.S. population is served by secondary treatment plants. T

The sewage of about 18% of the U.S. Population receives only primary treatment and that of an additional 8% is discharged directly to waterways. Soft surfactants will undoubtedly reduce foam from these sources, but whether they will eliminate foam is not yet known.

Approximately one-third of the population relies on cesspools, septic tanks and other forms of sewage treatment that are, for the most part, relatively anaerobic. The switch to LAS apparently will be of little benefit in cases where sewage disposal and water sources are close to each other and unfavorable soil conditions exist. (Many parts of the country, however, employ cesspool-septic tank systems without problems.)

Septic tanks, however, afford aerobic degradation conditions when operated with tile drain fields. And there's evidence that LAS can be effectively biodegraded when drain field conditions are good. But builders often skimp on out-of-sight drain fields and upkeep is neglected.

Upshot: Whether the national detergent problem will be solved by widespread use of LAS and other soft surfactants is not known. SDA believes that some foam problems are likely to remain.

The switch, however, will move the detergent business into a highly defensible position--whatever the total effectiveness of the new materials may prove to be. The industry will aver that it has produced materials that are degradable under effective sewage treatment conditions. It will contend that the detergent industry should not be penalized for the U.S. shortage of at least $2 billion worth of sewage disposal facilities. On this basis, it might be able to resist a third generation of surfactants, arguing that to switch again would only delay the construction of badly needed waste treatment facilities.

Abstract (continued)

U. S. waste disposal is inadequate
less than primary
direct discharge to waterways

Disease/Solid Waste
Abstracts

No. DSW-258

Author

C. A. Walker and J. A. Tallmadge

Title

Metal Finishing Waste Reduction

Reference

Chemical Eng. Progress (V. 55, No. 5)

Doc. No.	Contract No.	Date issued
May 1959, pp. 73		

Abstract

Metal-finishing operations, such as plating, anodizing, and bright-dipping, frequently produce large quantities of water-borne wastes. The most significant wastes are those produced in the very-thorough cleaning operations which precede the finishing step and in the rinsing operations after finishing. The wastes are likely to contain materials such as copper, zinc, chromium, cyanide and organic materials which interfere with the biological process occuring in natural waterways or in sewage disposal plants.

In a complex plant, drain lines for the following classifications of industrial wastes might be involved:

1. Clean wastes
2. Wastes to be treated.
    a. Acid wastes; from scale removal or plating operations, consist of mineral acids containing salts of metals such as Cu, Ni, Zn, Cr & Fe.
    b. Alkaline wastes; from phosphate, caustic, and silicate cleaners; from alkalis used as plating-bath ingredients, and from metal cyanides.
    c. Wastes bearing organic materials; as soaps, oils, grease, and lacquers.
    d. Wastes bearing recoverable materials.

In some cases, some or all of the wastes from a plant may be acceptable directly into a waterway or a municipal sewer system provided that peaks in flow rates or compositions are avoided by equalizing. In one complex electroplating plant 75% of the liquid waste could be sent directly to a receiving stream (4). The data of a waste survey are likely to be the only kind of results convincing to the members of regulatory agencies when this possibility is being explored (5).

Still other possibilities which might become apparent in a waste survey are

Descriptors

waste
chromium
acid wastes
oils
equalizing
copper
cyanide
alkaline wastes
grease
zinc
disposal
soaps
lacquers

Abstract (continued)

those of using one waste stream to treat another, using acid wastes to neutralize alkali wastes, or using the floc formed by neutralizing acid wastes containing copper, zinc, and other heavy metals to clarify other wastes (6).

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(4) Walker, C.A., and P. W. Eichenlaub, Sewage and Ind. Wastes, 26, 843 (1954).
(5) Swartz, C.J., Sewage and Ind. Wastes, 26, 1468 (1954).
(6) Walker, C.A., W. Zabban, R. W. Southworth and E. P. Heslin, Sewage and Industrial Wastes, 26, 849 (1954).

Disease/Solid Waste
Abstracts

No. DSW- 259

Author

Title

Simple Bio-Aeration Kills Strong
Wastes Cheaply

Reference

Chemical Engineering

Doc. No.	**Contract No.**	**Date issued**
Vol. 70 No.1, pgs.40-42		1-7-63

Abstract

A new bio-aeration system, based on action of microorganisms in a one-stage, prolonged biological process, is helping textile finishing mills remove up to 95% of biological oxygen demand (BOD) from streams containing strong starch-desizing wastes. And the technique may be applicable for other industries, such as manufacture of chemicals, sugar, starch, soap, glycerin, and pulp and paper, that also incur high-BOD wastes

Textiles Problem--Rapidly changing pollution laws are bringing the waste-disposal problems of textile finishers into sharp focus. Starch desizing wastes are notable culprits; though they typically account for only 25% of waste volume, their high BOD level causes some 50% of the pollution load.

Fourfold attractiveness--The Souther process, which handles the strong desizing streams along with dyes and other wastes, offers four advantages:

Lower capital and operating costs than for conventional trickling-filter or activated-sludge processes

No troublesome primary-settling tanks and anaerobic sludge digesters

Ability to treat sewage and any nontoxic organic wastes containing sufficient nutrients, with less adverse effect from variable flow, changes in pH, and shock organic loadings.

Flexibility in use of air to obtain desired effluent characteristics

Return of sludge to the aeration tank is necessary to obtain highest BOD removal efficiency through activation of incoming raw waste, as well as to promote total oxidation and stabilization of any excess solids in the effluent and thus minimize odor and de-aeration of receiving streams. Also, recirculation of cellulosic fibers found in sludge is necessary because of the longer time--up to 80 hr. or more--needed for their degradation. Recirculation also helps level out

Descriptors

wastes
bio-aeration system
BOD
starch-desizing wastes
pollution laws
Souther process
costs
sludge
aeration tank
oxidation
stabilization
cellulosic fibers
solids
recirculation
trickling-filter
activated-sludge plants

Abstract (continued)

wastes that vary in strength and temperature

Economics--Because Souther's process doesn't require the primary settling tanks or sludge digesters needed in conventional two-stage biological oxidation processes, investment and operating costs are both substantially lower than in traditional trickling-filter or activated-sludge plants.

Disease/Solid Waste
Abstracts

No. DSW- 260

Author

S. B. Hettig

Title

"Waste Farm"Takes Care of Phenolic

Waste Disposal

Reference

Chemical Engineering, Dec. 24, 1962

Doc. No.	Contract No.	Date issued
pp. 96		

Abstract

Phenol is easily detected in water, and in concentrations of only a few parts per million will give an unpleasant taste to drinking water after chlorination. An additional problem is that phenol is digested slowly by the various bacteria and therefore tends to pass through bio filter units without being completely removed.

We have found that a successful and cheap method of getting rid of these wastes is soil disposal. Success of this system requires a knowledge of the basic mechanics of soil disposal. There are a great many types of bacteria present in average soils, which digest wastes deposited as liquids or very low concentration slurries.

The normal bacteria count is constant in average soil where no extreme waste loads occur. As the wastes available for digestion increase, however, the bacteria multiply creating the effect of a naturally occurring bacterial filter system.

Soil disposal is not a new technique and was originally developed as lagooning. Here, the theory is that the wastes will percolate down through the soil from the bottom of the waste pond, and that the liquors will be purified naturally. This can be dangerous if subsurface faults allow large amounts of unconverted waste to contaminate the ground water.

The best way to avoid this problem is to spread the waste over a large area and take advantage of evaporation as well as bacterial digestion.

First, a plot of land large enough to handle a day's waste is plowed and disked as in normal farming practice. The area is calculated from a soil loading of 0.25 in/day/sq ft. Three to five times this amount is then prepared to avoid oversaturation of the soil.

The plot should be divided into sections that are sprayed in daily rotation

Descriptors

phenolic waste
soil disposal
evaporation
residual waste
disposal
slurries
bacterial filter system
costs
bacteria
lagooning
bacterial digestion

Abstract (continued)

to keep soil loading at a minimum. Light loading on any given section allows natural evaporation, leavint the waste behind to be digested and the soil dry for future loading.

For smooth operation, the plot should be periodically redisked and harrowed (about once a month) and replowed three or four times a year. These periods can vary depending on the quantity and concentration of waste.

Effectiveness of disposal can be checked by taking soil samples at varying depths and analyzing for residual waste. We have found that no trace of waste will exist past 3 ft. below grade.

Our five-year experience shows that a waste farm can be easily and economically installed and operated. The two most obvious benefits are elimination of extensive maintenance, and low labor costs.

Disease/Solid Waste
Abstracts

No. DSW- 261

Author

Title

Incineration Gobbles Up Plant Wastes

Liquid wastes make up the fuel that fires a rotary incinerator which, in turn, swallows everything but the kitchen sink.

Reference

Chemical Engineering, Oct. 1959, pp. 50

Doc. No. **Contract No.** **Date issued**

Abstract

Using a stationary furnace for combustivle liquid chemical wastes and a rotaty kiln for solid wastes, Dow's engineers polish off a stream of unruly material - toxic, explosive, smelly - without adding measurably to air pollution or plant hazards.

Waste Against Waste - In a sense, the incineration plant plays one waste against another. First of all, Dow reserves perhaps 15% of all liquid waste in order to fire the rotary kiln, a greatly modified municipal-type incinerator, 13 ft. in dia. and 35 ft. long.

Reasons for this go far beyond economy. By firing the kiln with highly combustible liquids, Dow gets high, even temperatures - close to 2,000 F. - throughout the kiln. This insures complete combustion of burnable materials within the kilin and, consequently, a clean stack effluent. And liquid-waste burning keeps the kiln hot when no refuse is moving through it.

Plastics are especially stubborn in this respect. Few furnaces can satisfactorily incinerate these materials for they melt and burn at the same time, the unburned viscous material dropping through grates and hardening on cooling.

Refuse also helps minimize the radiant heat problem posed by burning 8 gpm of liquid chemicals in the kiln.

Big Job - Dow's wastes are both fractious and bulky: some 400,000 gal/mo. of liquid still residues, washes, slurries and contaminated liquid products; more than 1,700 drums and other containers of semi-liquid and solid wastes per month; almost 17,000 cu. yd/mo of other refuse, including large amounts of plastics.

Liquid wastes, tucked from all areas of the plant, are dumped into 15 agitated tanks with a total volume of 110,000 gal. Two tanks receive high-Btu., low-ash tars for burning in the powerhouse. Others take solvents and water slurries. Still

Descriptors

Abstract (continued)

others, heated and insulated, are used for storing and blending hot phenolic tars above 80 C.

All solid wastes-except full drums and extremely hazardous materials - go to an 800 cu. yd. refuse pit. There a crane mixes the stuff and carries it to an incinerator feed hopper. From there the solids move along a conveyor into the feed chute for the kiln. When feed contains a high proportion of plastics, the conveyor slows to permit maintenance of high combustion temperatures in the kiln.

Explosive or toxic materials are fed to the kiln in their containers - whether they be fiber or metal drums, cans or bottles.

Small quantities of very toxic or explosive wastes are dropped down a small hole in the floor above the feed chute.

Tars Heat Kiln - Tars are fed from storage to horizontal, lowpressure burners at both sides of the feed end of the kiln. (Most of the tars are, of course, burned in the stationary incinerator - a conventional suspended, wall-type furnace). Light tars or waste solvents are usually burned at the burner tips, with the heavy tars being forced out into the kiln where refuse combustion takes place. This minimizes radiant heat effects on the feed chute and seal plate.

Secondary air and increased detention time in the turbulent zone insure complete combustion of the smoke.

Unburned residue - including drum fragments, tin cans, slag and ash - moves out of the kiln and drops into a quench trough holding 3-ft of water. Water used to knock down fly ash is sluiced to the quench trough as well. A conveyor at the trough's bottom picks up settled material, carries it up an incline and across a bar screen which separates metal from ash.

Disease/Solid Waste Abstracts

No. DSW- 262

Author

Title

Process May Reduce Pollution From Burning Coal Refuse Piles

Reference

Chemical and Engineering News

Doc. No.	Contract No.	Date issued
Vol 43, No. 4, Pgs. 49-50		1-25-65

Abstract

Nearly 500 mountains of coal refuse, waste material from coal cleaning operations, are burning uncontrollably in 15 states in the U.S., according to a Bureau of Mines survey. These refuse banks, some of which weigh as much as 20 million tons, ignite spontaneously and are nearly impossible to quench. Each year they pour thousands of tons of pollutants into the atmosphere.

The new approach for eliminating air pollution from this source was begun at Pennsylvania State University in 1962 by H. Beecher Charmbury, Pennsylvania's secretary of mines.

In the process, the unburned coal refuse is dumped into receiving hoppers and conveyed to a screening and crushing operation. Noncoal refuse, such as mineshaft timbers, is removed by screening. The coal is crushed to pieces less than 1 in. in diameter, and powder-sized coal particles discarded. The crushed coal refuse is carried to a cyclone extractor by a heavy slurry of flour-fine magnetite.

Float. The coal particles float in the heavy liquid while slate and stone sink. The high-speed action of the cyclone forces the slate, some of the magnetite, and the rock out the bottom of the cyclone extractor while coal is recovered at the top.

Slate and rock are screened and washed to recover the magnetite. Separated coal is also washed to recover the magnetite and then spun dry. Both wash streams combine, and the magnetite recycles.

About 50 tons of coal refuse can be processed in an hour, Mr Kindig says. Four tons of raw material will yield about 1 ton of usable coal. The pilot plant will be used to develop the process so as to make it economically attractive for coal producers to reprocess their own refuse banks.

Descriptors

process
pollution
coal refuse
pollutants
air pollution
cyclone extractor

Disease/Solid Waste Abstracts

No. DSW- 263

Author

Title

Reclamation

Reference

Chemical and Engineering News

Doc. No.	**Contract No.**	**Date issued**
Vol. 43, No. 4, p. 51		1-25-65

Abstract

A method for using metal from junked automobiles in treating nonmagnetic taconite, a type of iron ore now useless, is being developed at the Bureau of Mines' Metallurgy Research Center in Minneapolis, Minn. When scrap iron is mixed with nonmagnetic taconite and heated, the scrap absorbs oxygen from the ore. This causes the ore to change its molecular structure and become magnetic. The iron oxide can be removed by magnetic separation and sent to the blast furnace. A medium-sized plant using the process to make 5 million tons of taconite ore concentrate per year would use about 600,000 tons of scrap, Bureau of Mines estimates.

Descriptors

junked automobiles
taconite
scrap

Disease/Solid Waste Abstracts

No. DSW- 264

Author

Title

Pesticide Residue Problems Probed

Reference

Chemical and Engineering News

Doc. No.	**Contract No.**	**Date issued**
Vol. 42, No. 16, pgs. 32-33		4-20-64

Abstract

Endrin, a widely used pesticide, is the most likely cause of the massive fish kills which occurred in the lower Mississippi River late last year. This is the finding of the U.S. Public Health Service.

"The Louisiana fish kill presents a whole new dimension to the pesticide problem . . . since all evidence points to the fact that the fish kills are occurring despite use of the toxic materials as directed," Sen. Ribicoff said.

The Department of Agriculture held a hearing in Washington, D C., to determine whether registration should be altered or revoked for endrin, dieldrin, and aldrin. The presence of these materials in any food or liquid consumed by human beings is cause for concern, Mr. Quigley says, even though the levels may be far below those which might be considered an immediate health hazard.

There is no medical evidence to date that there have been any adverse health effects from these concentrations of pesticides, Dr. James M Hundley, Assistant Surgeon General, told the committee. Secretary of the Interior Stewart L. Udall told the committee, "Not until we have a systematic monitoring scheme, designed to tell us how much of what is where, will we be able to detect incipient problems early enought to prevent damage." In his opinion, persistent pesticides should be banned for agricultural use if movement of pesticide residues cannot be controlled. There has been some speculation that the residues of endrin and dieldrin might not be due to runoff from farms but might be due to spills from pesticide producing or repackaging plants.

Testimony at USDA's public hearing led to further speculation that spills from producing or repackaging plants might have caused pesticide residues. Shell's S.H.McAllister, general manager of the agricultural chemicals division, in referring to the fish kills in the Mississippi River, said, "We do not believe

Descriptors

endrin
fish kill
toxic materials
dieldrin
aldrin
health hazard
public health
pesticide

Abstract (continued)

that all the evidence is in."

According to Mr. Mc.Allister, "There is no evidence that there is any public health problem involved in the present situation...we see no need for precipitous action and we strongly recommend against it..."

Disease/Solid Waste Abstracts

No. DSW-265

Author

Title

Pesticide Levels Low in West Coast Fish

Reference

Chemical and Engineering News

Doc. No.	Contract No.	Date issued
Vol. 42, No 16, p 7		4-20-64

Abstract

Widespread use of chlorinated pesticides on the West Coast has not resulted, contrary to often expressed fears, in gross contamination of West Coast fish life, according to D. M. DeVries, E K Francis, and Dr P.E Porter of Shell Development, of Emeryville, Calif. Nor could they find any evidence of biological amplification, which is often postulated to be responsible for the build-up of hazardous levels of these pesticides in wildlife.

Biological Amplification. Samples of phytoplankton, zooplankton, shrimp, and pelagic red crab showed levels well below the 0.02-p.p.m. detection limit for DDE, dieldrin, and heptachlor epoxide and the 0 1-p.p.m. limit for isomers of DDT. These species represent a food chain. According to the theory of biological amplification, pesticides residues could be concentrated in each step of such a food chain. But there was no evidence to support this theory, Mr. DeVries says. The Shell scientists conclude that use of pesticides in the intensely farmed Central Valley has not contaminated the San Francisco Bay area watershed.

Descriptors

pesticide
contamination
DDE
dieldrin
heptachor eposide

Disease/Solid Waste Abstracts

No. DSW- 266

Author

Title
ABS Content in Laundry Wastes Cut: Method lowers alkyl benzene sulfonate content in coin-operated laundry wastes to 1 to 2 p p m

Reference
Chemical and Engineering News

Doc. No.	**Contract No.**	**Date issued**
Vol 39, No. 51, p.46-47		12-18-61

Abstract

Wastes from coin-operated laundries have been nearly freed of detergent contaminanats. An installation of 25 to 35 laundry machines discharges each week about 50,000 gal of water containing about 100 lb of detergent Discharge of this waste into the ground has led to well water pollution in some areas of the country, Suffolk County, Long Island, for one. Mr. Eckenfelder claims his method will lower ABS content in coin-operated-laundry wastes to 1 to 2 p.p.m. (50 to 90 p.p m are normally found in the waste).

Laundry operators estimate that a $5000 to $8000 cost for an installed unit and a 3-cent cost per wash would be economically attractive. In a batch treatment system, such as a multi-machine operation would use, the sludge resulting from the waste removal system would not be removed after each treamment cycle. Re-use of sludge is being investigated to see how much it will drop the cost of operating a waste treating unit.

In Mr. Eckenfelder's process the wastes are first treated with activated carbon. Activated carbon picks up soap and synthetic detergents which are in solution in the waste. Dirt, lint, and other contaminants suspended and in colloidal dispersion in the waste are coagulated and precipitated with alum. Activated carbon and alum remove nearly all contaminants and a clear, inoffensive effluent results. After treatment of the waste, the resulting sludge compacts to its ultimate concentration in four hours. The concentration of sludge attained varies from 1 to 2% by weight and occupies about 10% of the original volume of waste Mr. Eckenfelder concludes that through a combination of physical adsorption and chemical coagulation it is possible to remove substantially all of the synthetic detergent in wastes from coin-operated laundry operations

Descriptors

ABS
detergent contaminants
well water
cost
sludge
activated carbon
alum
contaminants
physical adsorption
chemical coagulation
synthetic detergent
laundry
waste

Disease/Solid Waste
Abstracts

No. DSW-267

Author
W. Allen Moore and M. B. Ettinger

Title
Recent Trends in the Analysis of
Industrial Wastes

Reference
Analytical Chemistry

Doc. No.	**Contract No.**	**Date issued**
Vol. 28, No 12/ pgs. 1819-1821		Dec 1956

Abstract

Estimates based on "population equivalents"(28) rate industrial wastes as responsible for more than twice as much stream pollution as municipal sewage discharges It has been further estimated that between 1950 and 1975 population will increase by about one third and industrial production will double.. Requirements for discharge of wastes to surface waters will, of necessity, become increasingly critical. Analytical means of gaging the suitability of wastes for discharge must be developed further as implements for protecting an increasingly critical public interest in water quality, without unduly hampering industrial activity.

The analytical work in progress does not appear to be adequate in relation to the expanded and critical waste control problem which it must eventually meet New industrial developments will cause new parameters of pollution to appear.
One important area of waste analysis cannot possibly be adequately covered by the chemist: the development of abasis for predicting the effects of a waste on the survival and growth of fishes and other aquatic life Under a given set of test conditions, fishes survived 8 p.p.m. of zinc alone and 0.2 p.p m of copper alone but were killed by a combination of 1 p.p m. of zinc and 0.025 p p m. of copper. The routine bioassay (6) for evaluating the acute toxicity of industrial wastes to fishes may be expected to come into more common use Surface waters at present serving millions of people are continuously dosed with industrial wastes containing undetermined amounts of unknown chemicals of undetermined toxicity.

The analytical procedures now used to measure industrial wastes are largely nonspecific tests drawn from the tradional techniques first devised for use in sewage. and operation and control of water purification processes.
An overwhelming mass of evidence has demonstrated that the real B.O.D of an

Descriptors

industrial wastes
population equivalents
stream pollution
municipal sewage
waste control
pollution
waste analysis
bioassay
toxicity
B.O.D.
pollutants
disposal
instrumentation
analytical procedures
research
C O D.

Abstract (continued)

industrial waste frequently cannot be satisfactorily measured unless an effective seed is developed (7, 10, 19, 27).

Oxygen consumed (O.C) or chemical oxygen demand(C.O.D.) has resumed its status as a measure of waste quality rather than a poor basis for estimating B O.D. There will be a growing need for more specific information the actual chemical identity of specific harmful pollutants in streams. An increasing trend for more specific and more sensitive procedures may be confidently predicted, both to supplant and to supplement the traditional procedures such as B O D , Co.O D., and odor.

Summary: During the next 20 years, surface water resources will become progressively scarcer Their use as a means of disposal of liquid industrial waste discharges will be subject to contined reexamination in the interests of the total economy There may be progressive restriction on the quality and quantity of liquid waste discharges. Intelligent control must be based on analytical methodology, which does not appear to be developing as fast as the control problem with which it is confronted. Present trends or future needs in the use of techniques for the analysis of industrial wastes are:

Instrumentation to measure and record waste quality.

Increasing use of bioassay procedures to control the suitability of water for fish.

Increasing need and pressure for examination of wastes for material toxic to man.

Development of new parameters of pollution for changing patterns of water use and changing nature of waste discharhes.

Further modification of the traditional analytical procedures borrowed from the field of sewage disposal and water plant operation to adapt them to better use in the examination of industrial wastes.

Increasingly specific waste analysis to pinpoint problems in waste control and to serve as the basis for research on waste properties and their effects in streams.

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**Disease/Solid Waste
Abstracts**

No. DSW- 268

Author
Robert N. Thompson, James E. Zajic, and
E. Lichti

Title

Spectrographic Analysis of Air-Dried Sewage Sludge

Reference
Journal Water Pollution Control Federation

Doc. No.	**Contract No.**	**Date issued**
Vol. 36, No. 6, pgs. 752-759		June 1964

Abstract

Over 7,500 wastewater treatment plants in the United States using some form of sludge digestion process. Seventy-one percent of these plants were using sludge drying beds for dewatering. The remaining 29 percent, particularly those serving the large communities, were resorting to some type of mechanical filtering and drying equipment or to sludge lagoons for storage of digested and undigested sludge. Regardless of the dewatering method the periodic "draw off" of the murky, viscous liquid representing the digested end-product of a controlled anaerobic fermentation process creates the troublesome problem of final disposition. With a total solids contribution in digested sludge of over 25 lb/yr/cap (11.4 kg) and an estimated population served by sewers of 130 mil, the annual production of sludge to be disposed of assumes impressive proportions. Many methods of disposal are used and vary with the locale, nature of the sludge, and economic factors, but perhaps the most commonly used method converts dried sludge into a fertilizer or, more accurately, a soil conditioner, with or without supplementation of plant nutrients.

In view of the apparent dearth of published data on the subject a spectrochemical investigation was undertaken to determine semi-quantitatively the metallic content of air-dried sludges and to obtain more definitive information on the chemical nature of the inorganic fraction of this complex.

The analytical data have been compiled and are presented in Table K. The 26 metallic components present have been grouped as major, intermediate, and trace elements. The major group includes concentrations ranging from 1 to 30 percent which may be recorded either in actual percent, as major (10 to 30 percent), or as minor (2.5 to 10 percent). The intermediate group includes concentrations ranging from 0.01 to 1.00 percent and the trace group 0.001 to 0.01 percent. The levels in these groups were chosen for convenience in presentation of the

Descriptors
sewage
sludge digestion
dewatering
drying
sludge lagoons
anaerobic
fermentation
disposal
fertilizer
soil conditioner
metallic components
sludge disposal
incinerate
ash
activated sludge
digested sludge
recovery
vitamin
sludges
vanadium
sodium
health
cholesterol
disease
spectrographic analysis

Abstract (continued)

data. Bold-faced figures indicate concentrations that would normally appear in a higher or lower grouping. All concentrations are reported as percentage of ash contents. Ash contents are reported as percentages of the air-dried sludge. No mositure determinations were made. However, with the exception of one sample, all the sludges were aged products of sand drying beds. The Oklahoma City Northside No. 2 sample was taken from a sand bed in which digested sludge had been dumped 24 hr previous to sampling. Examination of the data reveals that aluminum, calciu, and silica occurred as major components in most of the sludge samples.

Sludge disposal methods are quite varied and are influenced by geography, economics, and sludge characteristics. In some regions the wet, or partly dewatered, sludge is discharged at sea, into tidal estuaries, or into large streams during periods of flood runoff (6). Large cities often find it economically feasible to incinerate dried sludge and dispose of the ash in fills or waterways. Aavailability of land may suggest lagooning of wet sludge or land filling with sludge cake. Many municipalities have found wet and dewatered sludge to be marketable either as a low-grade fertilizer or, more profitably, as a soil conditioner. The success of such a venture will depend on the nature of the sluge, its preparation, and local market potential. Heat-dried activated sludge has been sold as a fertilizer by such cities as Milwaukee (Milorganite), Houston, and Chicago. Heat-dried digested sludge has been marketed by Los Angeles and San Francisco. Many municipalities sell or give away air-dried sludge with or without grinding. Prices and sales will vary with its acceptability by the public. In some cases where it is sold as a fertilizer the nutrient value will be reinforced by the addition of chemical fertilizers. In at least one instance known to the authors, air-dried sluge has been added to a garbage composting process to produce a soil conditioner.

Activated sludge has been explored as a source of vitamin B_{12} and such exploration revealed quantities sufficient to warrant installation of a recovery operation near the Milwaukee waste-water treatment plant (7) (8) (9).

The qualities of air-dried digested primary sludge vary considerably but, in general, may be as summarized in Manual of Practice No. 8:

Quality	Characteristics
Physical Testure	Granular friable lumps, about pea size if ground
Color	Black or dark brown
Odor	Earthy
Solids Content	About 40-percent total solids
Volume	25 to 50 percent of wet sludge applied
Volatile matter content	Average range 40 to 55 percent of the total solids
pH	6.0 to 6.5 after storage
Carbon, total	28 percent of dry weight
Nitrogen, total	2.3 percent of dry weight
Phosphorous, total	0.85 percent of dry weight

With the exception of the vitamin studies conducted in Milwaukee, all published analyses of sewage sludges have emphasized determinations of the plant food components present. Even when trace minerals were reported, it was still with the nutritional benefits in mind. This study was initiated in an effort to supply some conspicuously missing information on metals composition of sludges.

Abstract (continued)

In the sludges from Norman and Nichols Hills unusually high concentrations (1.0 and 1.5 percent, respectively) of vanadium were present. These two towns are primarily residential communitieis. Norman has some commercial and only light industrial waste contributions to its sewage. With this in mind, the total solids of the domestic water supplies were analyzed spectrographically. In both instances the local water supply proved to be the source of vanadium. High concentrations of sodium were present in the sludges of Norman and Oklahoma City and these were in like manner traced to the water supplies. The relatively high concentrations of sodium and vanadium were cites inasmuch as they have an established relationship to human health. Physiological requirements of sodium in bodily functions are well known and vanadium has been shown to have a possible function itn the control of cholesterol levels (10). There is an increasing interest among medical scientists in the role and potential role of all trace metals in disease.

The five elements manganese, iron, cobalt, copper, and zinc are known to be essential to life and health. These metals act as metallic cofactors in various enzyme systems.

Four other elements, titanium, vanadium, nickel, and chromium have biological activities of a catalytic nature, but are not at present thought essential to life. They are not accumulative in the human body. Cadmium, lead, tin, and aluminum do accumulate and are known to be biologically active. Chronic exposure to these metals (this does not preclude others) and resultant imbalances are possible contributory factors to disease (11).

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Disease/Solid Waste
Abstracts

No. DSW- 269

Author

Ramon M. Guzman

Title

Control of Cane Sugar Wastes in

Puerto Rico

Reference

Journal Water Pollution Control Federation

Doc. No.	**Contract No.**	**Date issued**
Vol. 34, No. 12, pgs.1213-1218		Dec.1962

Abstract

A series of rolls grinds the cane and extracts the juice, thus leaving the fiber, or bagasse, which usually is fed to the boilers for fuel and disposal.

The wastes produced in the cane sugar manufacturing process vary according to the local conditions, plant site, water availability, and other factors. The wastes can be roughly divided into three major groups; namely (a) cooling and condenser waters; (b) solid wastes from the filter cake; and (c) concentrated wastes from spillage, scum leaks, washings, cleaning, boiler blowdown and grease and oil from machinery.

The filter cake is also a solid with a high organic matter content. The wastes resulting from this cleanup are much higher in organic pollutants than the daily concentrated wastes, its pH having wide fluctuations because of the use of acids and alkalies in the cleaning operations. The concentration of organic pollutants in these wastes is also highly variable, depending on the units cleaned. When the clarifiers are cleaned the wastes are very strong, attaining a BOD in the range of 35,000 tp 75,000 mg/l. The clarifiers are usually cleaned only once or twice during the grinding season, which lasts about 5 months.

Sugar engineers may claim that the cooling and condenser waters contain little concentration of organic molecules, as very seldom does the alphanaphthol test for sugars (2) reflect its presence. However, because of the high BOD of sugar solutions even minute amounts produce considerable BOD loads.

The filter cake is the waste resulting from the clarification of the juice. The cake, separated from the juice in vacuum filters, generally is transported to the sugar fields near the factory, as it has a high fertilizer value. The escess cake is converted to a slurry and pumped to lagoons or to isolated areas, where it undergoes anaerobic decomposition.

Descriptors

bagasse
fuel
disposal
wastes
cooling and condenser waters
solid wastes
filter cake
concentrated wastes
spillage
grease
oil
pollutants
acids
alkalies
BOD
fertilizer
lagoons
anaerobic decomposition
carbohydrates
microorganisms
volatile acids
stabilization
solids
sugar cane

Abstract (continued)

Because of the high oxygen demand that the filter cake would exert if discharged to the receiving waters, precautions are taken to prevent its entrance to the river.

The concentrated wastes may be acid or alkaline, depending on the operations used, but no attempt is made to neutralize them. These wastes are difficult to treat because of their high concentration of carbohydrates.

The high concentration of carbohydrates in these wastes makes conventional treatment difficult, as the high production of volatile acid resulting from microbiological action inhibits the growth of microorganisms. Degradation of the carbohydrate molecules by microorganisms transforms the wastes into products of simpler molecular structure, but highly acid. A protein-sparing action is produced, the microorganisms utilizing the carbohydrates for energy in preference to other nutrients (4). Building up a buffer capacity to prevent excessive production of volatile acids is feasible, but difficult and expensive. Lime or other inexpensive alkali can be used to neutralize the acids produced, but the amount required is great, as demonstrated by the investigations conducted. Without the use of alkalies, the wastes, either acid or alkaline, produce volatile acids in concentration of about 2,000 mg/l after only one or two days retention with a lowering in pH to about 4.3.

A series of lagoons of sufficient capacity to hold the concentrated wastes produced during the entire crop were constructed to stabilize the wastes. One of the lagoons was to admit exclusively the concentrated wastes produced by the Sunday wash and unduly high concentrated wastes, as its high BOD might upset by overload the natural anaerobic process in the lagoons holding the daily wastes. The clean wastes, low in organic pollutants, were diverted and not permitted to mix with the concentrated wastes going to the lagoons.

The atabilization process in the first lagoon is slow at first, obviously because of the reduction in microbiological action resulting from the excess volatile acid production. However, the rate of stabilization is rapid after two or three days' retnetion. The decomposition proceeds at a logarithmic rate in the second lagoon, its pH going higher after the initial reduction to about 4.3. Eventually the rate of stabilization is lowered when the waste has attained a high degree of purification, usually when its BOD is 100/mg/l or less.

Pilot studies conducted at Louisiana State University have indicated that the stabilization of the strong wastes proceeds faster if the space available for lagooning is divided into several areas (6). The experience in Puerto Rico is similar in this respect.

After the end of the crop the sanitary engineers of the Authority perform weekly determinations of BOD of the retained wastes. The amount of wastes being known, it is possible to calculate the organic load in the wastes as well as the load that can be safely discharged without causing adverse conditions in the receiving stream. Forltunately, heavy rains generally occur in Puerto Rico in September, October, or November. When floods occur during this season the remainder of the stored wastes are discharged into the river. Once the stabilized wastes have been discharged the lagoons are cleaned and the solids are removed from the bottom to prepare them for the next crop.

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**Disease/Solid Waste
Abstracts**

No. DSW- 270

Author

Claude Z. Maehler and Arnold E. Greenberg

Title

Identification of Petroleum Industry

Wastes in Groundwater

Reference

Journal Water Pollution Control Federation

Doc. No.	Contract No.	Date issued
Vol. 34, No. 12, pgs. 1262-1267		Dec. 1962

Abstract

The oil well wastes, termed "formation waste-waters," are brought to the surface with the crude oil. In 1959 about 8.4 million barrels of this waste were produced (1). The waste was disposed of as follows: 8 percent was diluted with well water and used for irrigation of cotton and alfalfa, 30 percent was injected through wells below the usable groundwater, and 62 percent was discharged to unlined sumps for evaporation and percolation to the groundwater.

Production of refinery wastewaters amounted to about 2.7 million barrels in 1959. This waste consisted of cooling tower return, boiler blow-down waters, zeolite regeneration wastes, and, most important, process wastes. Ninety-five percent of these wastes were discharged to sumps.

The well samples contained organic pollutants ranging from 0.74 to 33.5 mg/l of organics. Roughly comparable data are given in the Public Health Service report on stream monitoring (5). It was pointed out in this report that clean streams may contain 0.02 to 0.05 mg/l of chloroform extractables, whereas for even highly polluted rivers chloroform extractables seldom exceed 0.3 mg/l. Rosen and Middleton (6), in studying a problem of petroleum waste pollution of surface water, found 1.38 mb/l of chloroform extractable materials in a canal, 0.184 mg/l in a lake near the refinery, and in the same lake about 10 miles distant from the refinery 0.041 mb/l.

The chloroform extractables of the domestic well water samples were roughly from two to five times greater than this standard. The irrigation well, although extracted with ether rather than with chloroform, showed about 160 times as much organics as the suggested standard.

Descriptors

petroleum industry wastes
groundwaters
oil well wastes
formation wastewaters
irrigation
unlined sumps
process wastes
irrigation
organic pollutants
oxygenated compounds
pollution

Abstract (continued)

As the distance from the source of waste increased, the fraction of oxygenated compounds likewise increased.

On the basis of the data collected during the course of this study, conclusions are as follows:

1. The wells sampled were grossly polluted with organic compounds.
2. The organic compounds found in the wells were clearly related to the compounds in the oil field wastes.

The evaluation described in this paper shows clearly the value of organic analyses in pollution studies.

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Disease/Solid Waste
Abstracts

No. DSW- 271

Author

B. P. Sen and T.R. Bhaskaran

Title

Anaerobic Digestion of Liquid Molasses

Distillery Wastes

Reference

Journal Water Pollution Control Federation

Doc. No.	Contract No.	Date issued
Vol. 34, No. 10, pgs 1015-1025		Oct. 1962

Abstract

The nature of the waste obtained from distilleries processing corn or grain differs considerably from the wastes produced from fermentation of cane sugar molasses. Concentration of the wastes and incineration to obtain potash salts has been suggested by Jackson (5) and experiments on anaerobic digestion of the wastes have also been reported by Stander et al. (6) in South Africa and Ono and Tanaka (7) in Japan. However, concentration of the wastes presents difficulties because of frothing and the corrosive nature of the waste.

Because of the high concentration of volatile solids and BOD in distillery waste, together with low nitrogen content, the spent wash presents difficulties in treatment. Physical methods of treatment (such as primary sedimentation) were found to be unsatisfactory. Addition of chemicals such as alum, ferric chloride, bentonite, activated charcoal, soap and lime was not found useful in treatment of the waste. Trickling filter treatment was found to remove about 75 percent of the BOD, but due to the high concentration of BOD of the spent wash and the low BOD loading that can be applied to a trickling filter, this method of t5eatment is considered unsuitable for adoption in practice because considerable space is required for the filters. Investigations were therefore undertaken to determine the usefulness of anaerobic digestion methods in the treatment of distillery waste.

Summary and Conclusions: Liquid waste from molasses distilleries creates an acute pollution problem in some states, particularly in Uttar Pradesh, in India. The wastes have high BOD, low nitrogen content, and present difficulties in treatment. Various methods of waste treatment were studied and it was noted that high-rate digestion provides an effective means of reducing the BOD of waste.

Descriptors

anaerobic digestion
distillery wastes
waste
fermentation
pollution
volatile solids
BOD
sedimentation
chemicals
trickling filter
treatment
cow dung
aerobic stabilization
methane
gas recirculation

Abstract (continued)

Detailed laboratory investigations were carried out to determine the optimum conditions under which high-rate digestion of the wastes can be carried out.

The important observations arising out of this work are as follows:

1. It is possible to carry out anaerobic digestion of waste at 37°C using cow dung as seen at BOD loading of 0.188 lb/day/cu ft, corresponding to a detention of 10 days.

2. Although distillery waste does not satisfy the minimum nitrogen requirements aerobic stabilization, nutrient addition in the form of aminonium salts was found to be unnecessary in the anaerobic digestion of the waste.

3. Different methods of stirring adopted in high-rate digestion have been compared. It was found that mechanical stirrers did not increase the rate of digestion, whereas gas recirculation was definitely of advantage in reducing tank volume and producing a better effluent.

4. Recirculation of CO_2 after separation from other constituents of the digester gas was tried in order to see whether CO_2 at an increased partial pressure can step up the reaction rate. This was found to be effective in reducing the BOD and volatile matter of the ffluent and increasing the percentage of methane in the gas.

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Abstract (continued)

TABLE I.—Composition of Spent Wash

Item	Range
Solids (mg/l):	
Total	70,000–120,000
Volatile	40,000– 70,000
Ash	30,000– 50,000
Suspended	1,000– 7,000
Dissolved	60,000–110,000
Nitrogen (mg/l):	
Total Kjeldahl	600–900
Ammonia	40–100
Protein	560–800
BOD, 5-day, 20° C (mg/l)	18,000– 37,000
COD (mg/l)	40,000– 90,000
COD/BOD ratio	2.0– 2.25
Potassium, as K_2O (mg/l)	5,000– 20,000
Reducing sugars (mg/l)	1,000– 10,000
pH	4.2– 4.5
Rate constant, K, BOD value/day at 20°C	0.15– 0.154
Total BOD demand, L	40,000– 60,000

Disease/Solid Waste
Abstracts

No. DSW-272

Author

J. Carrell Morris & Walter J. Weber, Jr.

Title

The Use of Adsorption for the Removal of Biologically-Resistant Pollutants from Wastewaters

Reference

Journal WPCF, March 1962, Vol. 34, No. 3

Doc. No.	Contract No.	Date issued
pp. 235		

Abstract

One distressing result of the technological growth and development at this time is that increasing numbers of exotic pollutants are being discharged into wastewaters and subsequently find their way into all sorts of water systems. Often these pollutants - synthetic organic materials with unnatural structures, such as branched-chain alkylarylsulfonates, types of chlorinated hydrocarbons, or polymeric ethers - are inert or strongly resistant to normal biological oxidation. As a result they persist for long times and distances in natural waters, either on the surface or underground. As reuse of water mounts, occasioned both by increasing population and growing use of water per capita, the level of such pollutants will continuously increase - in the absence of suitable methods for their removal - until they present a serious hygienic hazard.

Since the substances of concern are of molecular size and are resistant to attack by living organisms, neither the first stage, physical sedimentation, nor the second stage, biological oxidation, of conventional methods for the treatment of wastewaters is suitable for their removal. A third stage of treatment is needed, based on principles different from those utilized for the first two.

An important requirement for such a third stage is that it be chemically indiscriminate, for the variety of persistent pollutants is so great than any specific chemical method for the removal of a given class of material can provide only a partial solution to the general problem. Ultimately, it may be necessary to use complete phase-separation, as in techniques being explored for the desalinization of water. As an interim solution, however, other less drastic methods may be more economical.

Two types of treatment, adsorption and chemical oxidation, seem currently to offer the best prospects for development. Preliminary evaluation has indicated that

Descriptors

adsorption
exotic pollutants
polymeric ethers
sedimentation
chemical oxidation
nitrophenolic materials
pollutants
alkylarylsulfonates
reuse
biological oxidation
synthetic detergents
wastewaters
hydrocarbons
hygienic hazard
adsorption
organic pesticides

Abstract (continued)

adsorption, either or solid materials added to the wastewater or on flocculant materials formed in the wastewater, shows the greater promise.

Accordingly, an exploratory program of research on the effectiveness of a number of adsorbents in removing various types of persistent organic pollutants from wastewaters has been undertaken. The program covers studies on rates of adsorption, capacity for adsorption, and adsorptive equilibria for selected types of adsorbents, including activated carbon and metallic oxides. Measurements have been made on the removal of specific pollutants of current significance, such as synthetic detergents, organic pesticides, and nitrophenolic materials and also on removals of total residual organic matter from the effluent of typical sewage treatment plants.

The studies have been utilized to evaluate the significance of parameters affecting the efficiency of adsorption in the treatment of wastewaters, and to determine the mechanism of the inter action of specific pollutants with the adsorbents. The relative merits of various adsorbents are assessed in the light of the findings.

From the results of these studies a preliminary appraisal has been made of the feasibility of adsorptive methods both for providing a more complete treatment of domestic and industrial wastewaters and for the purification of water supplies containing biologically resistant pollutants.

Disease/Solid Waste Abstracts

No. DSW- 273

Author Committee on Refuse Collection
Am. Public Works Association

Title

Refuse Collection Practice, 2nd ed.

Reference

Am. Pub. Works Association, Research Fndn.

Doc. No.	**Contract No.**	**Date issued**
Pj. No. 101		1958

Abstract

The book provides a comprehensive text of current (1955) information concerning refuse collection practices throughout the United States. The following areas are thoroughly examined: refuse collection problems; refuse materials; their preparation for collection; factors affecting collection cost; collection methods; collection equipment; collection systems planning; supplemental transportation of refuse; special problems; municipal, contract or private collection; operations financing; organization; personnel; equipment management; reporting, cost accounting and budgeting; and public relations.

The appendices provides data from questionnaires submitted to all municipalities of over 5000 population. Typical ordinances for refuse collection, collection cost data, design criteria and a selected bibliography are also provided.

Descriptors

refuse
equipment
public relations
ashes
abandoned automobiles
receptacles
wage rates
vehicles
set-back method
compactor vehicles
schedules
scavengers
hazardous materials
private collection
personnel
cost accounting
collection
financing
waste
rubbish
quantity
cost data
garbage grinders
shoveling refuse
safety
planning
shuttling
condemned food
municipal operation
ad Valorem Taxes
equipment management
budgeting
disposal methods
organization
garbage
industrial refuse
sanitation
hauling distance
collection methods
set-out method
collection systems
routes
transfer stations
dead animals
contract collection
service charges
reporting
public relations

No. DSW-274

Author

Robert L. Francis

Title

Characteristics of Potato Flake Processing Wastes

Reference

Journal WPCF, March 1962, Vol. 34, No. 3

Doc. No.	**Contract No.**	**Date issued**
pp. 291		

Abstract

Severe stream pollution conditions have resulted when these wastes have been discharged untreated to a watercourse.

The waste from the potato flake industry is composed of sand, dirt, potato peel, potato trimmings, potato starch and solubles, and excess caustic from the lye peeler. Most of the sand and dirt is removed by settling in the sump. Potato peel, potato trimmings, and other solids are separated by coarse screening and are stored in hoppers for disposal. The remaining high pH liquid wastes usually are discharged to presettling basins for removal of settleable solids prior to discharge to municipal sewers or to other means of disposal.

The sand and dirt removed from the sumps are disposed of by burial. Potato solids removed by screening and settling may be utilized as animal food and fertilizer or disposed of by burial.

Characteristics of Wastes

The composition of the wastes from the three plants is illustrated in Table I. The values listed are the average of a series of analyses of composite samples collected from each plant. Wide variation in the pH, 5-day BOD, and suspended solids content of the wastes from each plant, as well as among the plants themselves was observed. As the manufacturing process is similar in all the plants, these variations could be contributed to production control of water and caustic within the plants.

Utilization of the proper amount of caustic for potato peel removal may influence the total suspended solids content of the wastewaters. Small increases in the pH of the wastewater coincided with higher BOD and total suspended solids.

The average volume of waste produced per ton of potatoes processed was 5,000 gal. The average 5-day BOD of the waste was 59 lb/ton of potatoes or equivalent in strength to the waste from a community of about 350 persons.

Descriptors

potato flake processing wastes
solids
burial
BOD
animal food
screening
fertilizer
caustic
stream pollution
disposal
composition
suspended solids

Abstract (continued)

TABLE I.—Composition of Potato Flake Processing Waste After Separation of Peel and Heavy Solids by Coarse Screening

Waste Characteristic	Plant			
	A	B	C	Average
pH	12.3	11.0	11.9	11.7
Turbidity (units)	602	380	—	491
Total suspended solids (mg/l)	4,500	1,800	1,440	2,580
Fixed suspended solids (mg/l)	890	390	108	465
Volatile suspended solids (mg/l)	3,590	1,410	1,330	2,110
5-day BOD (mg/l)	3,130	1,170	860	1,720
5-day BOD (lb/day)	3,790	2,420	3,580	3,270
Total suspended solids (lb/day)	5,450	3,760	5,990	5,070

Disease/Solid Waste
Abstracts

No. **DSW-**275

Author

William J. Burke

Title

Combating Health Hazards In The

Chemical Industry - Part I

Reference

Chemical Industries (N.Y.) 55:369-74

Doc. No.	**Contract No.**	**Date issued**
Sept. 1944		

Abstract

Workers engaged in the manufacture or use of chemicals are not only subjected to the more usual causes of industrial accidents, but because of the inherent physical and chemical properties of many of these materials, they are also exposed to the danger of systemic disease as a result of absorption of these substances into the body.

Injury to health may result from short- or long-time exposure depending upon the nature of the materials involved. When such injury results from a single exposure of short duration (anywhere from a few minutes to a few hours) it is classed as an accident under the Compensation Laws of New York State. In contradistinction to acute poisoning, we have sub-acute poisoning or chronic occupational diseases which result from prolonged exposure to relatively low concentrations of injurious substances.

During the past year the cost of compensation claims alone in New York State for injury resulting from exposure to harmful substances amounted to over a million dollars and involved injury to more than three thousand workers.

The portals of entry of toxic chemicals into the body are the respiratory tract, the digestive tract, sometimes the skin, or a combination of these channels.

A partial list of substances which may be absorbed into the body through the the skin and cause systemic disease is acrylonitrile, ethylene chlorohydrin, dimethyl sulfate, hydrogen cyanide, nitrobenzene, toluidine, trinitrotoluene (TNT), and organic metalic compounds of lead, arsenic and mercury. With the exception of aniline, nitrobenzene, and hydrogen cyanide, absorption of these chemicals through the skin usually plays a minor role as compared with other modes of entry into the body.

Danger from absorption through the skin may occur from spillage due to careless handling, an over-flowing tank, or a break in pipe line or some unit process-

Descriptors

Abstract (continued)

ing equipment. Other sources may be the continuous wearing of soiled work clothes or failure immediately to remove garments which have become accidentally soaked with chemicals capable of being absorbed through the skin. Garments contaminated with chemicals of a volatile nature may also expose the worker to the additional hazard of breathing their vapors.

By far the most important source of poisoning by chemicals is inhalation through the respiratory tract. Injurious substances entering the lungs may cause local damage to this organ; or by absorption into the blood stream may cause systemic disease with injury to the blood or blood-forming organs, the nervous system, or other organs of the body, particularly the liver and kidneys.

Dusts are air-borne solid particles disseminated into the atmosphere by such mechanical operations as crushing, grinding, mixing, screening, dumping, loading, packaging, conveying and various other mechanical operations. In general these industrial dusts range from 0.5 to 10 microns in size and most frequently average about 3 microns.

Smokes are solid particles suspended in air, but usually of smaller size than dust. They range from 0.2 to 1 micron and are produced by operations giving rise to fine particles, such as the melting or burning of metals or reactions between gases as in the formation of ammonium chloride from ammonia and hydrogen chloride. Fumes may also be produced by the direct condensation of a gas to a solid, or by the sublimation of such substances as sulfur, iodine, anthraquinone or phthalic anhydride.

Dusts and Fumes - Inorganic substances include such materials as the compounds of lead, antimony, mercury, thallium, selenium; oxides of arsenic, camium, calcium, manganese and zinc; the metallic fluorides; yellow phosphorus; the hydroxides and carbonates of sodium and potassium; and solid radioactive substances. Most of these materials when inhaled in sufficient quantities are capable of producing systemic poisoning. The hydroxides and carbonates of the alkali metals as well as calcium oxide, however, tend to produce only local irritating effects. Zinc fumes, while not regarded as poisonous, nevertheless produce anaphylactic reactions - the zinc shakes.

Organic dusts or fumes include such compounds as acetanilide, benzidine, dinitrophenol, dinitrotolune, the chlorinated naphthalenes and diphenyls, hexachloroethane, the naphthylamines, picric acid, trinitrotoluene, and tetryl. The toxicological effects of these compounds upon the body are too diverse for discussion here, but by way of illustration it may be pointed out that the chlorinated naphthalenes and diphenyls are especially toxic to the liver while substances such as the naphthylamines and benzidine are capable of producing cancer of the bladder.

In rescent years rather comprehensive tables have been published listing figures of maximum allowable concentrations of atmospheric contaminants of many of the common injurious materials.

The chief criticism of such tables is the general trend to accept the figures too literally and thereby give them more value than was intended by their authors. The values are based on the best experience and evidence available at the moment, but

Abstract (continued)

in many cases adequate supporting data are still lacking.

In issuing these tables it was not the intent, therefore, to imply that compliance with the figures listed would guarantee protection against ill health on the part of the workers exposed, nor would the maintenance of the recommended standards provide a substitute for medical control.

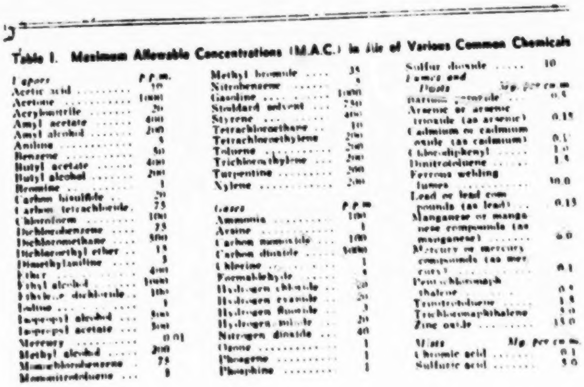

Table I. Maximum Allowable Concentrations (M.A.C.) in Air of Various Common Chemicals

Vapors	p.p.m.
Acetic acid	10
Acetone	1000
Acrylonitrile	20
Amyl acetate	400
Amyl alcohol	200
Aniline	5
Benzene	50
Butyl acetate	400
Butyl alcohol	200
Bromine	1
Carbon bisulfide	20
Carbon tetrachloride	75
Chloroform	100
Dichlorobenzene	75
Dichloromethane	500
Dichloroethyl ether	15
Dimethylaniline	5
Ether	400
Ethyl alcohol	1000
Ethylene dichloride	100
Iodine	1
Isopropyl alcohol	400
Isopropyl acetate	300
Mercury	0.01
Methyl alcohol	200
Monochlorobenzene	75
Mononitrotoluene	5
Methyl bromide	35
Nitrobenzene	5
Gasoline	1000
Stoddard solvent	750
Styrene	400
Tetrachloroethane	10
Tetrachloroethylene	200
Toluene	200
Trichloroethylene	200
Turpentine	200
Xylene	200

Gases	p.p.m.
Ammonia	100
Arsine	1
Carbon monoxide	100
Carbon dioxide	5000
Chlorine	1
Formaldehyde	5
Hydrogen chloride	20
Hydrogen cyanide	20
Hydrogen fluoride	3
Hydrogen sulfide	20
Nitrogen dioxide	40
Ozone	1
Phosgene	1
Phosphine	1
Sulfur dioxide	10

Fumes and Dusts	Mg. per cu. m.
Barium [illegible]	0.5
Arsenic or arsenic trioxide (as arsenic)	0.15
Cadmium or cadmium oxide (as cadmium)	0.1
Chlorodiphenyl	1.0
Dinitrotoluene	1.5
Ferrous welding fumes	10.0
Lead or lead compounds (as lead)	0.15
Manganese or manganese compounds (as manganese)	6.0
Mercury or mercury compounds (as mercury)	0.1
Pentachloronaphthalene	0.5
Trinitrotoluene	1.5
Trichloronaphthalene	5.0
Zinc oxide	15.0

Mists	Mg. per cu. m.
Chromic acid	0.1
Sulfuric acid	5.0

Disease/Solid Waste
Abstracts

No. DSW-276

Author

U.S. Pub. Health Service, Report of the

Title

Ohio River Pollution Control, Part 2

Supplements - An industrial waste guide to the canning industry.

Reference

78th Congress, 1st Session, House Doc. No. 266

Doc. No. | Contract No. | Date issued

August 27, 1943

Abstract

(Typical inspection report continuation sheet)

I-3
K 62.3

Consolidated Coke Co.,
Charleston, W. Va.

Water Supply:
Drinking—from city mains—Av. 34,600. Max. 36,000 g. p. d.
Industrial—Kanawha River—Av. 500,000. Max. 700,000 g. p. d.
Cooling—Kanawha River—Av. 2.5. Max. 3.0 Mil. g. p. d.

Raw Materials:
Coal—1,200 T. p. d.
Sulphuric Acid (26° Be)—15.6 T. p. d.
Caustic Soda (95%)—468 lb. p. d.
Lime—1,560 lb. p. d.

Products:
Coke—840 T. p. d.
Crude Phenol—1,000 lb. p. d.
Total, ammonium sulphate—12 T. p .d.
Tar—9,600 g. p. d.
Xylene—120 g. p.d.
Benzene—2,400 g. p. d.
Toluene—240 g. p. d.

Naphthalene is separated in final cooler and added to the crude tar. Crude tar is sold as such and not refined.

Wastes:
Total (from metered supply less loss in quenching)—2.8 mil. g. p. d.
Final Cooler (not recirculated)—378,000 g. p. d.
Ammonia Still Waste—26,000 g. p. d.
Benzol Carrying—18,000 g. p. d.
Quench water lost to atmos.—150,000 g. p. d.
Cooling—2.46 mil. g. p. d.

Spent sulphuric acid and residue from pure still are dumped on slag pile or burned.

Phenol is recovered as crude phenol by the Koppers Vapor recirculation process.

Analysis: Analyses show an average ammonia liquor phenol content of 3021 p. p. m. and the ammonia still waste contained 112 p. p. m. A recovery efficiency of 96.5%. Analyses are made daily by plant lab.

Outlets:
18″ circular tile at east end of Co. property, carrying cooling water, storm water, and sanitary waste.
2 6″ outlets carrying final cooler water, ammonia still waste, and benzol carrying waste, at rear of quench tower and 50′ west of pump house.

All may be measured by weirs in channel between outlet and river.

Remarks: Company does not contemplate any immediate expansion.

Descriptors

oil refinery waste
treatment
tables

Abstract (continued)

TABLE O-3. *Oil refinery waste: Classification of substances found in wastes from the oil refinery industry, as prepared by the American Petroleum Institute*

Refinery unit	Native solutes and those present in end products	Solutes present which result from chemical reactions	Naturally occurring emulsoids and suspensoids, and those persisting in end products	Suspensoids and emulsoids resulting from chemical and physical actions
1. Oil storage	(a) Organic sulfur compounds [1] (b) Acids: H_2S, CO_2, organic acids (c) Inorganic salts: NaCl, $MgCl_2$, Fe and Al compounds, $CaCl_2$, $(NH_4)_2S$, etc.		(a) Suspended matter in tank bottoms. (b) Insoluble salts, SiO_2, $Al_2 (SiO^3)$ 3, S, finely divided substances. (c) Asphaltic compounds (in some cases).	
2. Distillation: A. Straight distillation	(a) Organic nitrogen compounds [2] (b) organic sulfur compounds [1] (c) Phenol and like compounds (d) Naphthenic acids	(a) Inorganic salts, sulfites, acid sulfites, Na_2CO_3, $(NH_4)_2S$, Na_2S, sulfates, acid sulfates. (b) Acids and alkalies: H_2S, NaOH, NH_4OH, $Ca(OH)_2$ (c) $(NH_4)_2SO_4$, $(NH_4)_2S$, NH_4Cl	Insoluble organic and inorganic salts, S compounds, sulfonic and naphthenic acids, and insoluble mercaptides.	(a) Oil-water emulsions from steam in towers, etc. (b) Soaps. (c) Waxy emulsions. (d) Oxides of metals.
B. Cracking and distillation	Same as 2-A	Same as 2-A with the addition of phenols and phenolic compounds.	(a) Suspended coke (b) Insoluble salts, FeS, and SiO_2	Same as 2-A.
3. Treating: A. Sweetening, sulfuric acid, neutralization.	(a) Organic sulfur compounds [1] (b) Organic nitrogen compounds [2] (c) Naphthenic acids (d) Phenylates	(a) Organic sulfur compounds [1] (b) Phenolic and sulfonate compounds (c) Weak H_2SO_4 and other acid solutions. (d) Weak alkaline solutions (e) Soaps (f) Inorganic salts. $CaCl_2$, Na_2CO_3, Na_2SO_4, NaCl. (g) Oxides dissolved in alkaline solutions as PbO, CuO, etc.	(a) Suspended matter: PbS, S, S compounds. (b) Acid and alkaline sludges (c) Polymers and resins	(a) Waxy emulsions. (b) Oil water emulsions. (c) Inorganic salts: PbS, $CaSO_4$, $CaHPO_4$. (d) Soaps (e) Oxides: PbO, Fe_2O_3.
B. Clay	Same as 3-A	Same as 3-A, (a), (b), (c), and (f).	(a) Suspended clay earth (b) Polymers and resins	(a) Suspended clay, earth. (b) SiO_2, H_2SiO_3, $Al(OH)_3$.
4. Recovery: A. Gas purification and recovery.	(a) Organic sulfur compounds [1] (b) Organic nitrogen compounds [2]	(a) Inorganic salts: sulfates, acid sulfates, sulfites, acid sulfites, FeS, $(NH_4)_2S$, Na_2CO_3, Na_2S. (b) Mercaptides	Insoluble S compounds and mercaptides.	Suspended Fe and S compounds.
B. Acid recovery	(a) Sulfonates (b) Mineral acids (c) Organic nitrogen compounds [2]	(a) Inorganic salts, and H^2SO_4, SO_2, SO_3 (b) Organic esters	(a) Organic suspensoids: tars (b) Some sulfur compounds [3] (c) Some nitrogen compounds [4]	Acid sludges.
5. Miscellaneous: A. Cooling and boiler water treating.		Inorganic salts: $BaCl_2$, NaCl, $NaHCO_3$, Na_2SiO_3, $CaCl_2$, $MgCl_2$, Na_2CO_3, Na_2SO_4, Na_2HPO_4, $CaHPO_4$, etc.		Insoluble and colloidal compounds: $CaCO_3$, $BaCO_3$, $Ca(OH)_2$, $Mg(OH)_2$, $Ba(OH)_2$, $Ca_3(PO_4)_2$.
B. Fire protection		(a) Inorganic salts: $NaHCO_3$, Na_2SO_4, $Al_2(SO_4)_3$ (b) Organic compounds.		

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[1] Under this caption are included mercaptans, dialkyl sulfides, sulfonates, sulfonic acids, some alkyl and aryl sulfides, etc. Only a few of these compounds will be found in any one type of oil.

[2] Under this caption are included: amines, some nitriles, quinolines, and pyridines. Only a few of these compounds will be found in any one type of oil.

[3] Some alkyl sulfides, thiophenes, etc. Not all of these compounds are found in any one given type of oil.

[4] Quinolines, some amides, pyridines, and [illegible]. Not all of these compounds are found in any one given type of oil.

NOTE.—Asphalt and [illegible] that of [illegible] oils [illegible]

Disease/Solid Waste
Abstracts

No. DSW-277

Author

Herbert Charles Preul

Title

Travel of Nitrogen Compounds in Soils

Reference

Ph.D. Thesis, University of Minnesota 1964

Doc. No.	Contract No.	Date issued

Abstract

Nitrogen in ground water is of public health significance as an indicator of pollution and also as a direct cause of infant methemoglobinemia when consumed in the form of nitrates.

Two main factors are concluded to control the movement of nitrogen contaminated waters through soils. They are adsorption and biological action.

The main factors tending to retard the movement or reduce the concentration of nitrogen compounds in soils are adsorption, denitrification, and dilution.

In the form of nitrates and in the pH ranges of usual waste waters, practically no retardation to movement is offered.

Nitrates from soil absorption systems following septic tanks are a serious threat in the contamination of ground waters in their vicinity. Because of the shallow aerobic soil conditions in these systems, high rate biological action occurs within a few feet of the point of release into the soil. Under these circumstances, nitrification may dominate the deterrent effect of adsorption and rapidly change ammonia into nitrates.

Contamination of ground waters by forms of nitrogen may not be of serious consequence in the vicinity of aerobic waste stabilization ponds. Actions in the pond tend to largely consume the nitrogen thereby preventing high concentrations in percolating waters.

Descriptors

nitrogen
infant methomoglobinemia
biological action
septic tanks
stabilization ponds
soil
ground water
nitrates
denitrification
contamination
ammonia
public health
adsorption
dilution
aerobic

Disease/Solid Waste
Abstracts

No. DSW- 278

Author

H. B. Riffenburg and W. W. Allison

Title

Treatment of Tannery Wastes with Flue
Gas & Lime

Reference

Indus. & Eng. Chemistry, June 1941

Doc. No.	**Contract No.**	**Date issued**
pp. 801		

Abstract The steps in leather manufacture take place in the following order: (1) curing of the skin, (2) soaking, (3) liming, (4) unhairing, (5) deliming or bating, (6) tanning, (7) finishing. A waste produced in each step. The wastes from steps 1, 2, and 4 contain small amounts of material and are easily disposed of. The wastes from the other steps contain large quantities of colloidal and suspended matter, and some of them are highly colored. This condition makes their disposal difficult because of their tendency to clog sewage systems or to pollute streams.

Limes. These solutions contain certain decomposed skin constituents, various forms of sulfur and sulfur compounds from the decomposed proteins, emulsified fatty bodies of the flesh, carbonates, salts, and other substances.

Spent Tan Liquors (of Vegetable Origin). These solutions...are composed of some tannin, nontans, and hydrolyzed substances derived from the wood during extraction of the tanning extract....

A medium sized tannery (about three hundred hides a day) produces from 60,000 to 75,000 gallons of total wastes per day. The solid matter amounts to as much as 17,000 ppm or 11,000 pounds per day. The nature of these wastes makes them more difficult for a stream to decompose than ordinary sewage of an equivalent BOD. They may therefore be present in a stream many miles from the point of their entrance.

...Flue gas was used to precipitate the calcium hydroxide...experiments with ...wastes in...sulfuric acid, added coagulants such as aluminum sulfate, ferrous sulfate, lime, etc., and allowed the mixture to settle. ...Also used was alum as the coagulating agent in settling basins and separated the sludge on sand filters.

Some precipitation takes place when the wastes are mixed and produces a slight reduction in biochemical oxygen demand and color. Addition of mineral acids to the wastes which allowed them to flocculate reduced the charged colloids to near

Descriptors

flue gas
sludge
fertilizer
sulfuric acid
mineral acids
wastes
disposal
pollute

Abstract (continued)

their isoelectric point. Flue gas was a satisfactory and economical source of carbon dioxide.

The sludge was dewatered on cinder beds and used as fertilizer on the lawn. The high lime content of the sludge enhances its value as a fertilizer.

Disease/Solid Waste
Abstracts

No. DSW-279

Author Rhode Island Section Subcommittee on Stream Pollution

Title

The BOD of Textile Chemicals

Reference

American Dyestuff Reporter, May 23, 1955

Doc. No.	Contract No.	Date issued
pp. 355		

Abstract

SUMMARY AND CONCLUSIONS

1) The 5-day BOD of 64 textile chemicals and dyes was determined.

2) The 5-day BOD of 90 other chemicals was compiled from the literature.

3) Six curves are presented, showing the varying lengths of time for the BOD of various types of chemicals to be exerted.

4) The long-term BOD of substances with low 5-day BOD should be determined to ascertain whether they have a high delayed action oxygen demand.

5) The use of lower-BOD chemicals when possible will greatly relieve stream pollution caused by oxygen depletion during periods of low flow and high temperatures.

6) However, some substances with low BOD may have other objectionable qualities. For example, monochlorobenzene may have other forms of toxicity, and dyes with low BOD may cause objectionable color when discharged into a stream.

7) High BOD *per se* does not mean that a chemical should not be used, since the concentration and total amount discharged should also be considered.

8) The cost and efficiency of a chemical for a particular purpose should be considered as well as its BOD.

9) If large quantities of a low-BOD detergent (or other organic chemical) are discharged into a long river or small lake, cumulative detergent pollution may take place.

Descriptors

BOD
pollution
stream
monochlorobenzene
toxicity
detergent
pollution

Abstract (continued)

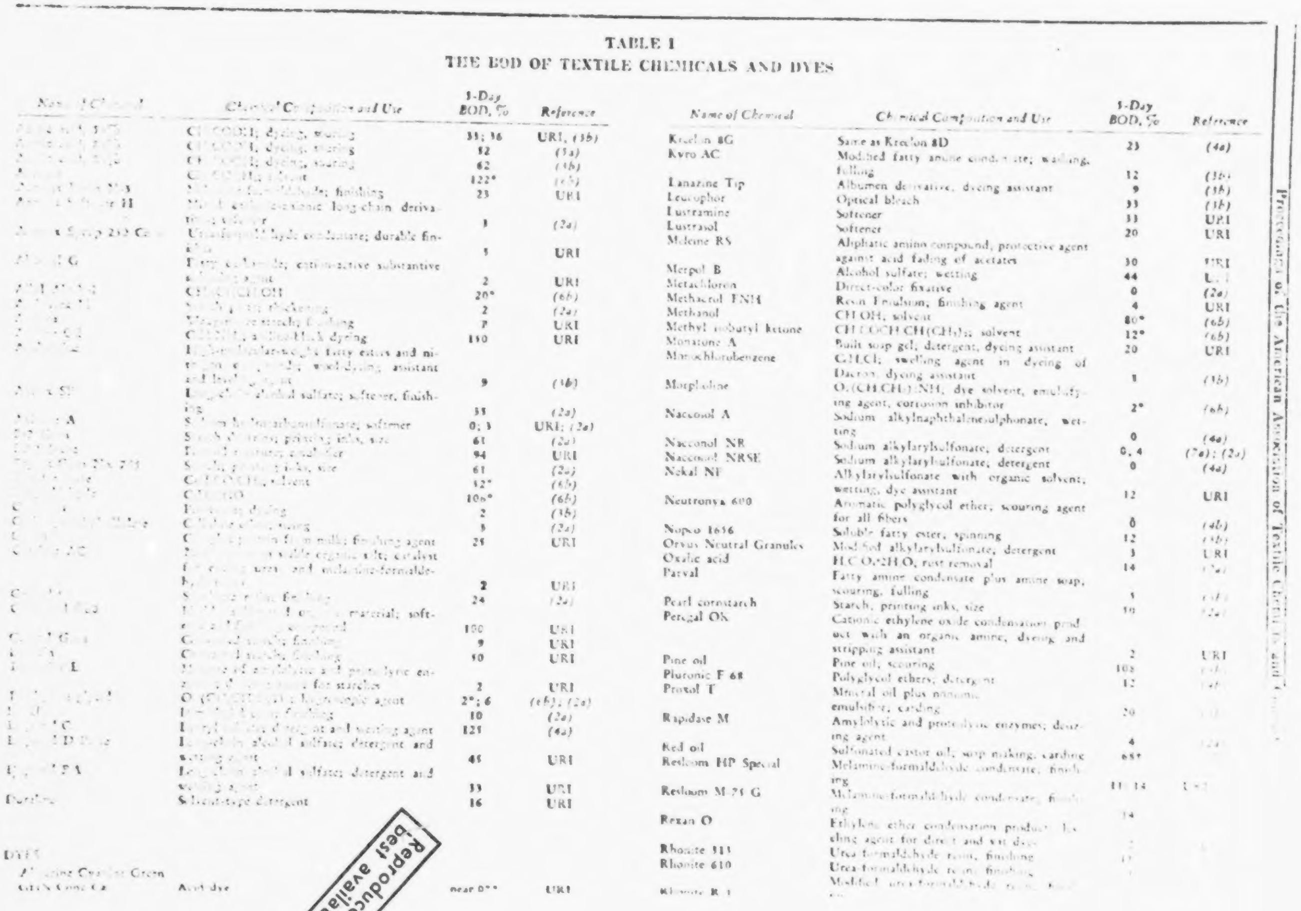

TABLE 1

THE BOD OF TEXTILE CHEMICALS AND DYES

Name of Chemical	Chemical Composition and Use	5-Day BOD, %	Reference
[illegible]	CH_3COOH; dyeing, scouring	35; 36	URI, (3b)
[illegible]	CH_3COOH, dyeing, scouring	52	(5a)
[illegible]	CH_3COOH; dyeing, scouring	62	(3b)
[illegible]	[illegible] solvent	122*	(6b)
[illegible]	[illegible] formaldehyde; finishing	23	URI
[illegible] H	[illegible] long-chain derivative; softener	8	(2a)
[illegible] Syrup 252 C[illegible]	Urea-formaldehyde condensate; durable finish	5	URI
[illegible] G	Fatty [illegible]; cation-active substantive softening agent	2	URI
[illegible]	[illegible] CH_2OH	20*	(6b)
[illegible]	[illegible] thickening	2	(2a)
[illegible]	[illegible] starch; finishing	7	URI
[illegible]	[illegible] aniline-black dyeing	150	URI
[illegible]	High-molecular-weight fatty esters and nitrogen [illegible]; wool-dyeing assistant and leveling agent	9	(3b)
[illegible] SP	Long-chain alcohol sulfate; softener, finishing	35	(2a)
[illegible] A	Sodium [illegible] sulfonate; softener	0; 3	URI; (2a)
[illegible]	Starch [illegible] printing inks, size	61	(2a)
[illegible]	[illegible] emulsifier	94	URI
[illegible] 73	Starch, printing inks, size	61	(2a)
[illegible]	[illegible] solvent	52*	(6b)
[illegible]	[illegible] O	106*	(6b)
C[illegible]	[illegible] dyeing	2	(3b)
C[illegible]	C[illegible]	3	(2a)
C[illegible]	C[illegible] protein from milk; finishing agent	25	URI
C[illegible] AC	[illegible] soluble organic salt; catalyst for curing urea and melamine-formaldehyde [illegible]	2	URI
C[illegible]	S[illegible] finishing	24	(2a)
C[illegible]	[illegible] material; softener [illegible]	100	URI
C[illegible]	Converted starch; finishing	9	URI
[illegible]	Converted starch; finishing	50	URI
[illegible] L	Mixture of amylolytic and proteolytic enzymes [illegible] for starches	2	URI
[illegible]	$O(CH_2CH_2OH)_2$; hygroscopic agent	2*; 6	(6b); (2a)
[illegible]	[illegible] finishing	10	(2a)
[illegible] C	Lauryl sulfate detergent and wetting agent	125	(4a)
[illegible] D [illegible]	Long-chain alcohol sulfate; detergent and wetting agent	45	URI
[illegible] PA	Long-chain alcohol sulfate; detergent and wetting agent	33	URI
[illegible]	Solvent-type detergent	16	URI
DYES			
[illegible] Green [illegible]	Acid dye	near 0**	URI
Kreelon 8G	Same as Kreelon 8D	23	(4a)
Kyro AC	Modified fatty amine condensate; washing, fulling	12	(3b)
Lanazine Tip	Albumen derivative, dyeing assistant	9	(3b)
Leucophor	Optical bleach	33	(3b)
Lustramine	Softener	33	URI
Lustrasol	Softener	20	URI
Meleine RS	Aliphatic amino compound, protective agent against acid fading of acetates	30	URI
Merpol B	Alcohol sulfate; wetting	44	URI
Metachloron	Direct-color fixative	0	(2a)
Methacrol FNH	Resin Emulsion; finishing agent	4	URI
Methanol	CH_3OH; solvent	80*	(6b)
Methyl isobutyl ketone	$CH_3COCH_2CH(CH_3)_2$; solvent	12*	(6b)
Monatone A	Built soap gel; detergent, dyeing assistant	20	URI
Monochlorobenzene	C_6H_5Cl; swelling agent in dyeing of Dacron, dyeing assistant	1	(3b)
Morpholine	$O:(CH_2CH_2)_2:NH$, dye solvent, emulsifying agent, corrosion inhibitor	2*	(6b)
Nacconol A	Sodium alkylnaphthalenesulphonate, wetting	0	(4a)
Nacconol NR	Sodium alkylarylsulfonate, detergent	0, 4	(7a); (2a)
Nacconol NRSE	Sodium alkylarylsulfonate; detergent	0	(4a)
Nekal NF	Alkylarylsulfonate with organic solvent, wetting, dye assistant	12	URI
Neutronyx 600	Aromatic polyglycol ether; scouring agent for all fibers	0	(4b)
Nopco 1656	Soluble fatty ester, spinning	12	(3b)
Orvus Neutral Granules	Modified alkylarylsulfonate; detergent	3	URI
Oxalic acid	$H_2C_2O_4 \cdot 2H_2O$, rust removal	14	[illegible]
Parval	Fatty amine condensate plus amine soap, scouring, fulling	5	[illegible]
Pearl cornstarch	Starch, printing inks, size	10	[illegible]
Pergal OK	Cationic ethylene oxide condensation product with an organic amine, dyeing and stripping assistant	2	URI
Pine oil	Pine oil; scouring	103	[illegible]
Pluronic F 68	Polyglycol ethers; detergent	12	[illegible]
Protol T	Mineral oil plus nonionic emulsifier; carding	20	[illegible]
Rapidase M	Amylolytic and proteolytic enzymes; desizing agent	4	[illegible]
Red oil	Sulfonated castor oil; soap making, carding	68*	[illegible]
Resloom HP Special	Melamine-formaldehyde condensate, finishing	11; 14	[illegible]
Resloom M-75 G	Melamine-formaldehyde condensate, finishing	14	[illegible]
Rexan O	Ethylene ether condensation product, leveling agent for direct and vat dyes	[illegible]	[illegible]
Rhonite 313	Urea-formaldehyde resin, finishing	[illegible]	[illegible]
Rhonite 610	Urea-formaldehyde resin; finishing	[illegible]	[illegible]
Rhonite R-1	Modified urea-formaldehyde resin, finishing	[illegible]	[illegible]

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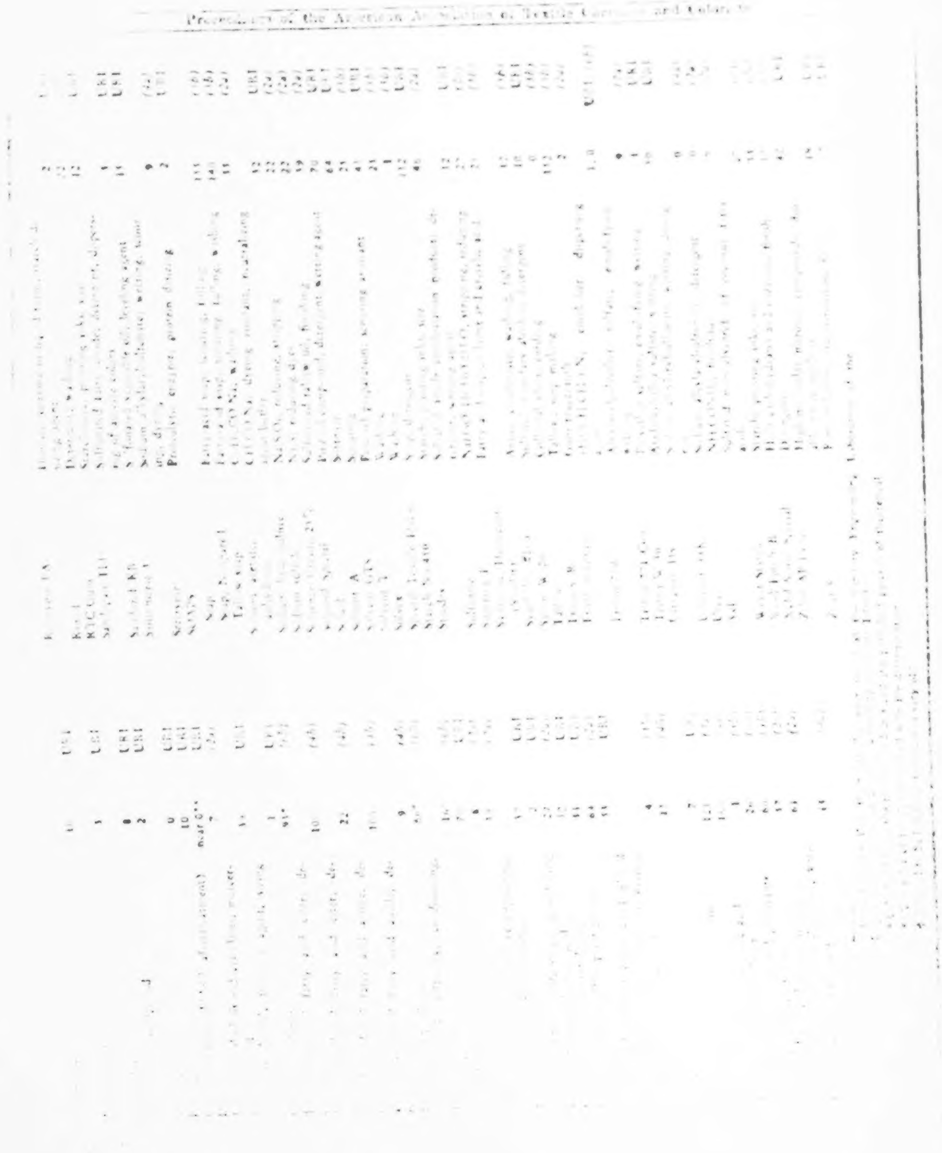
Abstract (continued)



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Disease/Solid Waste Abstracts

No. DSW-280

Author

Harry B. Hommon

Title

Studies on the Treatment and Disposal of Industrial Wastes (3) Purification of Tannery Wastes

Reference

Public Health Bull. No. 100, 1919

Doc. No. **Contract No.** **Date issued**

Abstract

There is no doubt as to the value of the solids removed from tannery wastes as a fertilizer, especially for clay ground. Compared with ordinary manure fertilizers they rank higher than stable manure, pound for pound of dry material, in all the essential constituents except potassium, and the presence of the calcium carbonate in the tannery sludge is a distinct advantage. The following analyses of sludge show the complete results of several determinations and in addition an analysis of horse manure taken from Ohio Agricultural Experiment Station Bulletin No. 246, p. 726 (See Table 35).

The figures given in the analyses for tank C cover a period of operation extending from November 16, 1915, to June 30, 1916, and give a very fair average for the composition of the solids in the waste over an extended period. In comparison with horse manure such as is obtained from the ordinary horse stable the average of tannery sludge results shows almost twice as much nitrogen, and more than twice as much phosphate, but only about one fourth as much potassium. In addition there is a high percentage of lime which most land requires unless it lies directly over beds of limestone.

...The solids from a tannery settling pond or disposal plant will be at least equal to the value of manure.

The process of treatment recommended is, in general outline, as follows:

Treatment of the spent-tan liquor with lime sludge from the unhairing vats, followed by about 24 hours quiescent sedimentation.

Mixture of the supernatant from this treatment with the remainder of the wastes and treatment of the combined wastes with copperas (ferrous sulphate), at the rate of about 10 grains per gallon.

Sedimentation of the mixed wastes in a tank having sufficient capacity to

Descriptors

manure
sedimentation
sludge
treatment
wastes
fertilizer
lime sludge
filtration
tannery

Abstract (continued)

permit 24 hours operation of the filters, and to provide for a minimum time of passage during the daytime of 4 hours.

Preliminary filtration of the settled liquors through cinder roughing filters at about 200,000 gallons per acre per day.

Sedimentation in tanks for about one hour.

Secondary filtration through beds of coarse sand.

Addition of the sludge from the spent-tan liquor treatment to the main sedimentation tank at frequent intervals and withdrawal of the sludge from the latter and from the secondary sedimentation tank to sludge-drying beds as necessary.

Utilization of the dried sludge as a fertilizer.

Direct utilization of the liquid sludge to fertilize near-by land by means of tank wagons may be found more economical than the use of drying beds under certain conditions.

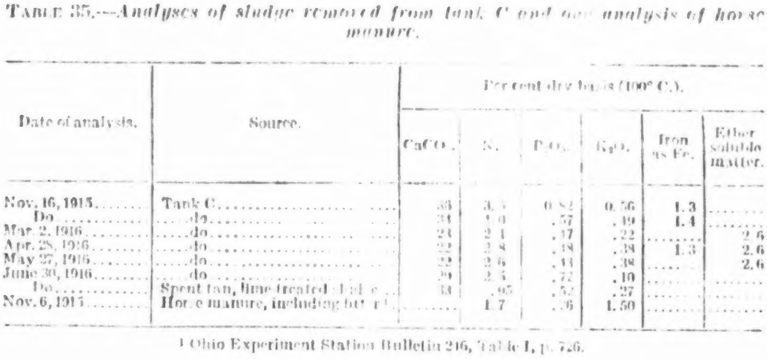

TABLE 35.—*Analyses of sludge removed from tank C and one analysis of horse manure.*

Date of analysis.	Source.	Per cent dry basis (100° C.).					
		$CaCO_3$.	N.	P_2O_5.	K_2O.	Iron as Fe.	Ether soluble matter.
Nov. 16, 1915	Tank C	33	3.5	0.82	0.56	1.3	....
Do	do	31	4.0	.57	.49	1.4	....
Mar. 2, 1916	do	24	2.1	.17	.22	....	2.6
Apr. 28, 1916	do	22	2.8	.18	.38	1.3	2.6
May 27, 1916	do	22	2.6	.11	.38	....	2.6
June 30, 1916	do	20	2.5	.72	.10	....	....
Do	Spent tan, lime treated sludge	13	.95	.52	.27	....	....
Nov. 6, 1915	Horse manure, including litter[1]	....	1.7	.26	1.50	....	....

[1] Ohio Experiment Station Bulletin 216, Table I, p. 726.

No. DSW-281

Author

Harry B. Hommon

Title

Studies on the Treatment and Disposal of Industrial Wastes. 4) Purification of Creamery Wastes

Reference

Pub. Health Bull. No. 109, 1921

Doc. No. **Contract No.** **Date issued**

Abstract

The individual wastes that made up the composite for any one day at the testing station consisted of the following general classes:

(1) Waste water from washing churns, cans, and other utensils. Under this heading are included the wash water from cleaning all apparatus used in the creamery.

(2) Scrub and rinse water from the floors. This waste includes the milk, cream, buttermilk, and skimmed milk spilled on the floors and the miscellaneous dirt that collected.

(3) All acids used in testing the milk, together with the chemicals from the laboratory used in connection with the creamery and testing station.

(4) Waste from toilets and wash rooms.

Sludge from sewage and practically all industrial wastes can be dried on suitable beds located near the disposal plants and the dried residue hauled away for fill or for use as a fertilizer on land. The peculiar strong odor from creamery waste sludge, however, prevents the adoption of this method. On account of the comparatively small volume of waste from the dairy products industry and the consequent small amount of solids to be disposed of, it is not so essential to carry out dewatering processes at the treatment plants for these wastes as it is for those plants purifying domestic sewage and many other industrial wastes.

The only practicable methods, therefore, that remain for disposing of creamery waste sludge is either to haul it away from the treatment plant and deposit it on land or bury it in shallow trenches near the disposal plant.

Descriptors

waste
sewage
solids
creamery
acids
industrial wastes
land
sludge
fertilizer
bury

Abstract (continued)

TABLE 2.—*Table showing weighted average of raw waste at Grove City testing station, and analyses of wastes¹ from various branches of dairy industry.*

Source of samples.	Results in parts per million.								
	Organic nitrogen.	Nitrogen as ammoniacal.	Oxygen consumed.	Suspended matter.	Total solids.	Ether soluble matter.	Chlorine.	Acidity to phenolphthalein.	Alkalinity.
WASTES FROM MAKING BUTTER, COTTAGE CHEESE, CONDENSED MILK AND CASEIN.									
Grove City Creamery, Grove City, Pa.	81	1.65	782	517	3,238	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 3.—*Monthly averages of chemical and bacteriological analyses of influent¹ and effluent of Imhoff tank.*

	Temperature, ° F.			Chemical analyses (p. p. m.).									
							Nitrogen as:						
	Influent.	Effluent.	Air.	Suspended solids.	Residue on evaporation.	Turbidity.	Total organic.	Ammoniacal.	Nitrites.	Nitrates.	Acidity.	Oxygen consumed [illegible] 96° C.	Oxygen demand [illegible] hours at 20° C.
							Influent.						
1916.													
May 16-17	71	74	56	286	....	1,750	254	2.0	....	....	[illegible]	2,550	
May 19-20	78	72	49	200	6,834	1,700	181	0.8	....	....	[illegible]	2,220	[illegible]
May 22-23	73	72	57	672	....	1,100	110	1.0	....	....	[illegible]	[illegible]	
May 25-26	77	80	62	1,048	5,692	2,000	152	1.5	0.016	....	[illegible]	2,200	[illegible]
Average	75	75	56	552	6,263	1,712	182	1.3	0.016	....	126	[illegible]	2,750
							Effluent.						
1916.													
May 16-17	....	....	....	432	....	1,400	128	12.0	....	....	148	1,760	....
May 19-20	....	....	....	232	3,200	660	84	4.0	....	0.002	324	1,110	2,400
May 22-23	....	....	....	332	....	700	88	2.4	....	0.250	316	[illegible]	1,960
May 25-26	....	....	....	412	2,588	780	56	4.0	0.012	0.012	208	910	1,560
Average	....	....	....	350	2,890	860	80	5.6	0.012	0.064	249	1,335	1,973

¹ Raw waste.

TABLE 9.—*Table showing analyses of air-dried sludge from the Sunbury Cooperative Creamery Co. and the testing station at Grove City Creamery Co.*

Date.	Source.	Per cent ash.	Per cent dry basis (100° C.).							Per cent Silica (SiO_2) in ash.
			Moisture.	Nitrogen.	Ether-soluble matter (fats).	Calcium as CaO.	Potassium as K_2O.	Phosphorus as P_2O_5.	Iron as Fe.	
November 11, 1916	Sunbury	36.6	33.5	1.51	35	4.07	0.11	1.28	1.9	62.3
November 19, 1917	Grove City	10.8	83.9	2.00	43	6.40	.80	1.40	2.6	61.1

Disease/Solid Waste Abstracts

No. DSW- 282

Author

Donald D. Gold

Title

Summary of Treatment Methods for Slaughterhouse and Packinghouse Wastes; IN Tenn. Eng. Exp. Station, Bulletin 10-18,

Reference

Engineering Experiment Station, Bulletin No. 17; Univ. of Tenn.

Doc. No.	**Contract No.**	**Date issued**
		1953

Abstract

SYNOPSIS

Slaughterhouse and packing house wastes are largely organic in character. The content of these wastes is related to their origin within the plant. The content of the mixed wastes depends upon plant operations, plant recovery practices, and good housekeeping. Those plants recovering blood and grease and removing paunch contents by hand or screens will have greatly decreased the undersirable contents of their wastes.

Whole blood when recovered may be dried and used for plywood adhesive, livestock feed, protective colloid or as a fertilizer ingredient. It may also be processed for by-products.

Grease recovery is an important first step in aiding the treatment and disposal of slaughterhouse and packinghouse wastes. Grease can cause scum formation in primary tanks and may cause difficulties in secondary treatment processes. The recovery of grease is profitable, and well-designed grease recovery units are being installed in nearly all slaughterhouse and packing house plants.

Many auxiliary methods have been used as adjuncts to grease recovery. These include diffused aeration, mechanical aeration, chemical coagulation and aero-chlorination. It is questionable whether, under ordinary market conditions, the expense of these auxiliary methods is justifiable unless they are needed to prevent stream pollution.

Methods similar to those for treating domestic sewage are applicable to slaughterhouse and packinghouse wastes. Whenever possible it is economical for such wastes to be treated with sewage at a municipal sewage treatment plant. Pre-treatment of packinghouse wastes is desirable before they are discharged to municipal sewers.

Experimental, pilot plant, and full scale plant waste treatment studies have

Descriptors

slaughterhouse
disposal
chemical coagulation
trickling filters
settling tanks
leaching pits
filter beds
settling
pollution
packinghouse
aeration
aero-chlorination
sand filters
septic tanks
dry wells
cesspools
low-rate filtration
paunch manure
fertilizer
mechanical aeration
sewers
activated sludge
disposal fields
filter trenches
flocculation
final sedimentation

Abstract (continued)

shown that trickling filters, sand filters or activated sludge will give satisfactory secondary treatment of wastes from slaughterhouses and packinghouses. Chemical coagulation has also been shown to give satisfactory results.

In many states, wastes from small slaughterhouses and packinghouses have been treated in settling tanks or septic tanks followed by sub-surface disposal fields, leaching pits, dry wells, filter trenches, filter beds, or cesspools in series. Underground disposal of wastes proved unsatisfactory at several plants in Tennessee because the liquid could not be kept underground. In some sections of the United States, streams are dry part of the year and few persons would consider as satisfactory the discharge to the stream of such wastes after only primary treatment.

Some of the treatments, in addition to grease removal, comprise the following: (1) Mechanical flocculation, settling, low-rate filtration and final sedimentation, (2) Primary settling, high-rate filtration, intermediate settling, low-rate filtration and final sedimentation, (3) Primary settling, aeration, secondary settling, low-rate filtration and final settling, (4) Screening, primary settling, primary filtration, intermediate settling and standard filtration of the packinghouse wastes; the effluent from the standard filters is mixed with primary settled sewage and the mixture aerated in activated sludge tanks followed by settling, (5) conventional trickling filter plant.

CONCLUSIONS

1. Slaughterhouse and packinghouse wastes often require treatment prior to discharge to streams in order to prevent serious pollution of such streams.
2. The recovery of grease and blood at the source aids in solving the problem of packinghouse waste treatment and may yield a profit.
3. Paunch manure should preferably be removed in the dry state or if it is allowed to enter the waste waters it should be removed by rotary or vibrating screens.
4. Small slaughterhouses in certain areas have obtained satisfactory treatment with settling tanks or septic tanks followed by sub-surface disposal fields, leaching pits, dry wells, filter trenches or filter beds if grease, blood and paunch manure have been carefully removed prior to treatment. More positive treatment is obtained with chemical coagulation (chlorine, ferric chloride), sand filtration or high-rate filtration.
5. Wastes from large packinghouses have been successfully treated in admixture with municipal sewage ranging from 5 to 90 percent packinghouse waste. The packinghouse wastes should receive pretreatment before discharge to municipal sewers.
6. Where treatment at a municipal sewage treatment plant is not possible, the wastes from large packinghouses may be successfully treated using treatment methods similar to those employed by municipal sewage treatment plants.

Abstract (continued)

TABLE 1
Comparison of Water Usage Per Animal Slaughtered (2)

Company	Daily kill		Gal of Water used	Gal of water used per	
	Animals	Hog units		Animal kill	Hog unit kill
C	165	400	85,000	185	75
G	700	1,830	320,000	475	177
E	380	632	54,000	222	85
E	452	640	193,000	246	171
			Average	282	127

TABLE 2
Unit Packinghouse Losses, Chicago, Illinois (4)

Plant No	Kill		Liquid loss (gal per ton)	Pollutional losses (lb per ton)			
	Type	Tons per day		BOD	Suspended solids	Nitrogen	Grease
1	Hogs	51	5,500	36.0	24.0	5.34	1.80
2	Hogs	114	2,200	30.1	18.2	2.58	4.61
3	Mixed	127	2,600	25.4	9.1	4.05	2.88
4	Hogs	139	4,900	26.2	19.6	2.50	5.66
5	Cattle	148	1,900	41.5	29.6	4.47	1.35
6	Cattle	165	2,800	31.4	29.5	4.02	3.58
7	Cattle	168	2,000	21.0	19.9	2.04	2.01
8	Mixed	185	2,800	39.4	18.8	5.18	1.20
9	Hogs	190	4,500	19.5	14.3	2.93	0.54
10	Mixed	303	4,600	33.4	29.9	4.37	4.00
11	Cattle	397	6,200	20.0	22.0	2.16	1.10
12	Mixed	429	6,500	29.4	26.5	3.41	3.00
13	Mixed	661	2,600	13.0	12.5	1.58	1.00
14	Mixed	680	8,700	38.5	44.3	4.20	4.20
Average			4,130	28.9	22.7	3.49	2.64

TABLE 3
Analyses of Major Packinghouse Wastes (6)

Source	Concentration ppm									pH
	Solids		Nitrogen				Cl as NaCl	Oxygen		
	Total	Susp	Org	NH_3	NH_2	NO_3		Consumed	Demand	
Hog dehairing	1,540	560	158	10.0	0.02	—	290	620	650	6.7
Hair cook water	4,680	80	586	30.0	0.00	—	290	—	3,400	—
Hair wash water	7,680	6,780	822	18.0	0.02	0.1	230	1,680	2,200	6.9
Curing room (A)	26,480	1,800	83	12.0	5.00	95.0	19,700	2,520	2,040	7.3
Cured meat-washing	9,560	920	109	17.5	5.00	—	6,700	950	1,960	7.3
Curing rooms (B) showers	34,100	1,720	255	25.0	1.00	8.0	29,600	875	460	6.7
Meat cutting	2,840	610	33	2.5	0.17	0.2	1,620	260	520	7.4
Killing department	1,840	220	134	6.0	0.07	—	435	500	825	6.6
Sausage and miscellaneous	11,380	560	136	4.0	1.25	—	880	460	800	7.3
Lard department	820	180	84	25.0	1.00	—	230	200	180	7.3
By-products	4,000	1,380	186	50.0	0.02	2.5	1,330	970	2,200	6.7
Laundry	18,620	4,120	56	5.0	0.02	0.1	—	780	1,300	9.6
Scalding tub	13,560	8,360	1,290	40.0	0.00	—	640	4,300	4,600	9.0
Blood and tank water	44,640	3,690	5,400	205.0	0.00	—	6,670	—	32,000	9.0
Gut washer	22,600	15,120	643	43.0	0.00	—	360	—	13,200	6.0
Pickle	110,000	--	2,750	37.0	150.00	750	77,800	—	18,000	5.6

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* Less than 0.1 ppm

**Disease/Solid Waste
Abstracts**

No. **DSW-** 283

Author

M. E Batz

Title

Deep Well Disposal of Nylon Waste Water

Reference

Chemical Engineering Progress

Doc. No.	**Contract No.**	**Date issued**
Vol. 60, No. 10, pgs. 85-88		Oct. 1964

Abstract

Waste Characteristics: Analysis of the various waste streams indicated the composite waste that would be considered for underground disposal to be composed of organic monobasic and dibasic acids, nitric acid, ammonia, adiponitrile, hexamethylenediamine, sodium hydroxide, sodium carbonate, alcohols, and ketones. Interaction of alkaline and acid wastes, and the concentrations of solids produced, indicated that the waste would require surface treatment before the process waste streams could be discharged directly into the injection well The lagoons would allow for interaction of waste, for aging, and for sufficient settling time to remove solids. No pretreatment was provided other than settling, aging, and maintaining the pH below 5.0.

Underground injection of industrial waste is expected to be a very economical and dependable method for disposal of concentrated mylon waste. The capital and operational costs are approximately one-tenth that of the conventional bio-oxidation system; there are no refractory or low-level BOD wastes discharged to the river; there is no sludge disposal problem, as compared with conventiional bio-oxidation systems.

Descriptors

disposal
underground disposal
nylon waste
solids
injection well
lagoons
settling
aging
nitric acid
ammonia
adiponitrile
hexamethylenediamine
sodium hydroxide
sodium carbonate,
alcohols
ketones
alkaline
acid wastes
costs
bio-oxidation
BOD
sludge
industrial waste

Disease/Solid Waste Abstracts

No. DSW- 284

Author

Title
Pesticide Pollution Studies - Progress Report

Reference U S. Dept. of Health, Ed. & Welfare; Public Health Service; Div. of Water Supply & Poll.Control, Region IV,At.,Ga.

Doc. No.	**Contract No.**	**Date issued**
		Mar.1963

Abstract

Flint Creek Project (1959-Fev.1963): The study area is a 400 square mile Northern Alabama watershed drained by approximately 760 miles of stream tributary to the Tennessee River. Flint Creek and the West Fork of Flint Creek are the principal streams in the basin. Water quality and agricultural practices were investigated from 1959 through 1962.

Cotton is the only crop requiring significant quantities of insectices. Most of these are applied as dusts by ground equipment. Insecticide usage is probably conservative because of small cotton allotments. The extent of insecticide usage by farmers in the watershed was estimatee by statistical methods. Generally speaking confidence limits (0.05) were set on these parameters by using the sample standard error, the Student "t", and a finite population correction term. Minimum usage (58,500 pounds technical) pccurred in 1960 and maximum (139,500 pounds) in 1962. Usage estimates in 1959 and 1961 were 85,570 and 99,346 pounds technical, respectively.

The data presented show taxaphene and BHC were present in raw and finished water throughout the year, every year. Apparently the toxaphene and BHC content of the water was not reduced by treatment. The recovery data seem to support the intuitive assumption that insecticide contamination in water is related to the solubility of the product.

The insecticide probably originated from the basin in general rather than from a few cotton fields or sub-watersheds. Because of continuous surveillance it is certain there were no large fish kills in the drainage system in 1959 and 1960 resulting from the normal agricultrual use of insecticies.

Bayou Tech-Yokely Project (March 1961-January 1962). In 1961 a study was initiated in St. Mary's Marish, Louisiana near the town of Franklin. The Parish

Descriptors

pesticide pollution
insecticides
dusts
toxaphene
BHC
contamination
endrin
carbon adsorption
dieldrin
BHC
soil

parathion
DDT
DDD
captan
raw sewage
sludge
industrial treatment plant

Abstract (continued)

is in the coast marsh area and is near sea level. The streams studied were Bayou Teche and Bayou Yokely. Bayou T chce drains over 2000 square miles; however, its precise drainage area in the vicinity of Franklin is indeterminate. Bayou Yokely has a well defined drainage area of 12.1 square miles delineated by a dike and levees formed by the Teche. Sugar cane is virtually the only crop grown in the Yokely Basin. A total of 3,313 acres of cane is grown in the basin and the average plantation size is 237 acres. The cane is treated from the air for control of cane borers with clay pellets containing 2% technical endrin by weight. A total of 1,959 pounds of technical grade endrin was applied to 3,313 acres in 1961.

Eighteen carbon adsorption samples obtained from Bayou Yokely were analyzed for pesticide residue using microcoulometric gas chromatography. The quantities of insecticide recovered were as follows: six samples contained from 1 to 360 parts per trillinon (ppt) endrin; 14 samples contained from 5 to 1,361 ppt dieldrin; and two samples contained from 3 to 4 ppt of an undertermined isomer (s?) of BHC. The median concentration of endrin and dieldrin in positive samples was 101 ppt and 427 ppt, respectively. Dieldrin is often applied to soil around building foundations for termite control Conventional water treatment, including the addition of carbon for taste and odor control, is not effective in removing small quantities of insecticide (s) from water.

Spartanburg Project (March 1960-Feb. 1961). In the spring of 1960 investigations were started in a peach growing area of Spartanburg County, South Carolina The study concerned a 2.7 acre pond located on a 40 acre watershed where peaches are the principal crop Insecticide usage information was obtained from the farmers and water, hydrosoil, soil, and biological samples collected. From April 11 to August 1, approximately 152 pounds of technical grade parathion were applied as a wettable powder to 34 acres of peaches. Other pesticides used were dieldrin, DDT, BHC, and captan, in amounts minor compared to parathion. A composite surface soil sample collected in March prior to parathion use in 1960 contained 1.7 parts per million (ppm) parathion. This indicates parathion survival in the soil for a period of at least nine months. Surface soil samples collected from August 1960 to February 1961 contained from 0.23 to 1.39 ppm parathion. Two series of vertical samples taken to a depth of four feet indicated the presence of parathion at depths ranging from one to two feet.

Choccolocco Creek-Coosa River Study (May 1961-June 1962). In May 1961, at the request of the Alabama Water Improvement Commission. studies were started in a stream receiving wastes from a plant which manufactures parthion and methyl parathion For chemical and toxicological analysis, samples were obtained of: raw sewage and thickened sludge from the city sewage treatment plant. Waste obtained from the industrial treatment plant contained 234 ppm (untreated) and 13 ppm parathion (treated). The untreated influent and the thickened sludge from the city treatment plant contained 4 ppm and 667 ppm parathion. respectively.

Abstract (continued)

Table I

CONCENTRATION OF BHC AND TOXAPHENE RECOVERED FROM CARBON ADSORPTION SAMPLES COLLECTED FROM FLINT CREEK, ALABAMA, 1959-1962

	Raw Water		Finished Water	
	Parts per trillion			
Year	Median	Range	Median	Range
		BHC		
1959	50	4-210	29	20-70
1960	63	10-217	60	15-200
1961	143	32-1004	123	23-640
1962	188	41-809	320	48-824
		Toxaphene		
1959	41	10-260	59	34-280
1960	41	9-270	55	10-410
1961	39	18-164	37	15-111
1962	37	7-148	44	5-154

The above data represent analyses made on 141 residues including 59 paired raw and finished water samples collected during synchronous sampling periods. All analyses were by microcoulometric gas chromatography.

Disease/Solid Waste Abstracts

No. DSW- 285

Author
William S. Foster

Title
Nature and Magnitude of the Municipal Solid-Waste Disposal Problem

Reference Proceedings... Third Pittsburgh Sanitary Engineering Conference. Municipal Solid Wastes Disposal. Published by U. of Pittsburgh

Doc. No.	**Contract No.**	**Date issued**
Pages 1-7		11-4-61

Abstract

Nature and Magnitude of the Municipal Solid-Waste Disposal Problem: To introduce a subject such as this provides the opportunity of injecting a facet that often slips by many engineering groups: the personal or human factor. Of all the endeavors assigned to engineers, few indeed have this factor of human nature so thoroughly embedded in them as does the subject of solid-waste disposal. Do not be surprised to find a well developed plan canceled out because the factor of human nature suddenly assumed unpredictable proportions. When we consider the nature and magnitude of solid waste disposal, let us remember that "human nature" is a lively factor, and that this places dimension on the magnitude that often is difficult to measure.

The late Hendrick Van Loon summed it up pithily when he said, in his Report to St. Peter, that a lot of people have starved to death, but nobody has stunk to death. Then one day the bacteriologists proved him wrong. They showed that flies and mosquitoes are recognizable vectors in the transmission of disease. They also rolled up a formidable array of evidence showing that the rat is a physical foe, as well as a means of disease transmission. While the smell itself might not kill, where the smell is, so are these disease carriers.

If present trends continue, and we repeat that they rarely do, some concentration of population densities probably will reach maximums of 10,000 to 15,000 per square mile. This can mean only that incinerators, or some similar method that physically reduces the volume of the refuse, will have to become more popular. It also means that we will have to develop more refined methods of transferring the refuse from small trucks to large. It could mean that we will develop a fool-proof residential incinerator, but unless such a unit moves out of the luxury class, one can scarecely see how it will become widespread enough to seriously affect the large-scale refuse

Descriptors

human factor
solid waste
disposalflies
mosquitoes
vectors
disease
disease carriers
incinerators
refuse
collection
sanitary
composting
disposal
landfill
fleas
typhus
roaches
grinders
fly ash
air pollution
physical manpower
municipal

Abstract (Continued)

collection and disposal patterns.

This introduces the question of how to select a proper disposal method. Let us not do more than make a broad generalization. If land is available a city saves money by making use of the sanitary landfill method. If it becomes scarce, willy-nilly, one has to turn to an incinerator. You justify incinerators when the cost of trucking to a distant fill site over-balances the cost of the incinerator--taking into account, of course, those human factors that we discussed previously.

This panel has competent men who can discuss not only the sanitary fill, but also incineration and the more exotic method of composting.

We know that a rat will migrate as much as four miles in a week. Thus, when the rat colony in the open dump becomes crowded, the more adventurous will emigrate to new fields. Some will go to farms and eat the grain in barns, some to warehouses, and others will find their way to the cribs of babies.

Rats frequently bite a baby around the mother, attracted by the smell of milk on the baby's lips. One night in St. Louis, a mother, awakened by the screams of her three month old child, was horrified to find a large rat chewing the baby's nose. When she shoved the rat away, it turned and bit her. Another rat chewed off the little finger of a two month old baby.

Of course, we tend to forget that rats, by carrying disease, have killed more people than all wars in history. In an uncomfortable number of cases, rats are carriers of fleas that in turn are typhus carriers.

You will have no trouble at all digging up other circumstantial evidence against the rat, but the thought of a rat in a baby's crib ought to be sufficient to convince even the most stubborn that a city is not serving the best interests of its people by conducting its refuse disposal operations in a way that provides food and shelter for the rat. We will let you decide whether this is emotional reasoning or cool, objective analysis.

Still another method that is worth at least passing attention is that involving the kitchen food-waste grinders. This is a handy device for improving home sanitation. It quickly and positively gets rid of the decayable portion of household refuse that breeds flies, roaches, and causes ordor problems.

Nevertheless, we still find a great deal of opposition to the use of grinders. New York flatly and stubbornly bans them and the Allegheny County Sanitary Authority (Pittsburgh) assesses an additional rental charge against the home with a garbage grinder. This is an annoyance, but in view of the general troubled world conditions, I doubt that we will get much grass roots interest in working hard to change these policies.

1. We need an inconspicuous incinerator.
2. We need a better method of extracting the fly ash from the incinerator gases.
3. We need a way to determine fly ash content in the stack gases.
4. We need a better standard to control air pollution.
5. We need some way to make an incinerator scream when it is overloaded.
6. We need some easy way to determine how well an incinerator is operating.
7. At sanitary fills, we need a truck that will bale the refuse.
8. We need a method of collecting refuse that doesn't require so much physical manpower.

Disease/Solid Waste
Abstracts

No. DSW- 286

Author

Casimir A. Rogus

Title

Incineration

Reference Proceedings...Third Pittsburgh Sanitary Engineering Conference. Municipal Solid Wastes Disposal. Pub. by U. of Pittsburgh

Doc. No.	Contract No.	Date issued
Pages 24 & 29		11-4-61

Abstract

Descriptors

cost
refuse
disposal
incineration

Abstract (continued)

TABLE I

COST OF REFUSE DISPOSAL BY INCINERATION
(Unit Costs per Ton of Refuse Destroyed - 1960 Cost Index)

	Continuous-Type, Newest 5 Plants	Batch-Type, Old 4 Plants	Weighted average for 9 Plants
CONSTRUCTION COSTS			
Total Cost per Ton-per-Day of Design Capacity (exclusive of land)	$5,500.	$3,750.	
OPERATING COSTS			
Direct Costs			
Operating Labor	2.93	5.82	3.37
Maintenance Labor	.17	.35	.23
Residue Disposal:			
Hauling	.28	.34	.30
Landfilling	.71	.36	.76
Overhead and Administration	.33	.65	.43
Total Direct Costs	$ 4.42	$ 8.02	$ 5.59
Indirect Costs			
Fringe Benefits	.97	1.68	1.20
Vehicle Maintenance	.11	.14	.12
Utilities	.10	.10	.10
Materials and Supplies	.12	.14	.13
Capital Amortization @ 3%	.95	.65	.85
Total Indirect Costs	$ 2.25	$2.71	$2.40
Total Operating Cost Per Ton	$ 6.67	$10.73	$7.99

Abstract (continued)

TABLE II

DISTRIBUTION OF CONSTRUCTION COSTS FOR EQUIPMENT AND BUILDING (BY FUNCTION) PER TON-DAY

(1958 Cost Index)

	Architectural and Structural	Mechanical	Electrical	H & V Plumbing and Misc.	Total Cost	Percent of Total
DELIVERY OF REFUSE (Tipping Floor, Scales and Accessories)	$ 337.	$ 4.	$ 14.	$ 18.	$ 373.	8%
HANDLING OF REFUSE (Storage Pit, Cranes, Hoppers and Accessories)	658.	141.	14.	27.	840.	17%
BURNING OF REFUSE (Furnaces, Flues, Chimneys, Combustion Chamber, and Accessories)	955.	1,321.	121.	55.	2,452.	51%
RESIDUE REMOVAL (Ash Cellar, Conveyors, Controls and Accessories)	309.	108.	66.	41.	524.	11%
FLY ASH REMOVAL (Subsidence Chambers, Screens and Accessories)	113.	15.	9.	9.	146.	3%
MISCELLANEOUS (Utilities, Grading, Landscaping, Demolition, Furniture, Tools)	313.	127.	30.	16.	486.	10%
TOTAL COSTS	2,685.	1,716.	254.	166.	4,821.	100%
Percent Distribution	55%	36%	5%	4%	100%	

Disease/Solid Waste
Abstracts

No. DSW- 287

Author
Harold B. Gotaas

Title
Planning Municipal Composting Facilities

Reference Proceedings...Third Pittsburgh Sanitary Engineering Conference. Municipal Solid Wastes Disposal. Pub. by U. of Pittsburgh

Doc. No.	**Contract No.**	**Date issued**
	p. 44	11-4-61

Abstract

Summary

1. Studies of the type of refuse available for composting and the probable market for the compost are the most essential steps in planning a composting operation.

2 A considerable portion of the cost of refuse disposal normally expended by a city should be available to support composting, if the total cost of refuse disposal would be reduced.

3. Analyses indicate the cost of composting to be between two and six dollars per ton, which is less than the cost of incineration but more than the cost of land fill disposal, except when exceptionally long hauls are required.

4. Five unit processes are involved in compost operations: (a) receiving, (b) segregation and separation, (c) grinding or shredding, (d) decomposition, and (e) market preparation.

5. Plant design should include provision for flexibility of operation with respect to quality and quantity of refuse, separation and salvage and market preparation.

Descriptors

refuse
composting
market
disposal
cost
land fill
incineration
receiving
segregation
grinding
decomposition
market
salvage
municipal

Disease/Solid Waste
Abstracts

No. DSW- 288

Author

Hillel I. Shuval

Title

The Economics of Composting Municipal

Refuse.

Reference Proceedings Third Pittsburgh Sanitary Engineering Conference Municial Solid Wastes Disposal Pub. by U. of Pittsburgh

Doc. No.	**Contract No.**	**Date issued**
pgs. 47-57		11-4-61

Abstract

Market for Comparison. The Agricultural Experimental Station as well as agricultural extension officers in Israel have successfully demonstrated the beneficial results of adding organic fertilizer and soil conditioner to these overworked soils. The need has become even greater with the rapid spread of modern intensive farming techniques which aim at even higher yields. It has been estimated that the country badly needs some 1 million m^3 of additional organic fertilizer per year to meet minimum needs.[3]

Recently, with the introduction of mechanical conversion of fresh refuse to compost in the plants in Tel viv and Haifa, the quality has been improved considerably and the organic content ranges from 25 to 35%, with nitrogen (N) running about 1%. This improved fertilizer quality as well as the removal of glass and metal fragments has resulted in the increased price of 9IL ($5.00) per m^3 or at times more, which the farmers are prepared to pay They usually prefer the compost of higher quality, despite its price but today the supply is still limited.

A rough preliminary calculation has been made which would indicate that if all of the refuse of Israel's estimated urban population in the year 1975 (2,000,000) were to be composted, some 300,000 - 400,000 m^3 of compost would be put on the market annually. If all municipal refuse in Israel were composted it would meet only from one-third to slightly less than one-half of the demand as predicted by the agricultural authorities It is therefore anticipated that the market for high grade municipal compost will continue to hold its own at current price levels for many years to come.

Capital costs for new incinerators in the United States have been reported to average $3,300 per ton of rated capacity[8] in 1956 with construction costs

Descriptors

economics
composting
refuse
market
fertilizer
soil conditioner
compost
refuse
municipal refuse
costs
incinerators
Dano Biostabilizer
salvage

Abstract (continued)

rising at an increasing rate. Capital costs for composting plants are in the same range. Total operating costs of incinerators in the United States, including amortization, ranged from $1.50 to $3.00 per ton in 1955 as reported by William S. Foster,[9] while L. Weaver of the U.S.P.H.S. reported incineration to run as high as $5.00 per ton of raw refuse handled.[10] He contends that many communities report only operational expenses of incineration, neglecting the large capital costs.

For the composting plants reported on here, the cost of converting a ton of raw garbage is about $5.75 for the Haifa plant and $4.30 for the Tel Aviv plant. These figures and information from similar European plants seem to indicate that the costs of composting and of incineration are not far apart.

Summary and Conclusion: A preliminary study was made of the economic aspects of two composting plants in Israel operated on a concession basis. One is an existing 50 ton per day enclosed Dano Biostabilizer plant in Haifa, the other is a 500 ton per day plant for grinding refuse in two stages with equipment manufactured by Dorr-Oliver of Holland and composting in open windrows turned every three to four days for a period of about three weeks. The analysis is a preliminary one, but it appears that both plants will make a profit. Despite the differences in the design, production costs at both plants are similar: 10.30 IL ($5.75) per m^3 of compost at Haifa and 11.53 IL ($6.42) per m^3 at Tel Aviv, or $7.65 per ton and $8.55[3] per ton. Income from sale of compost which averages about 9.00 IL ($5.00) per m^3 (about $6.70 per ton), in Israel does not cover all the production costs. Only municipal subsidies and the sale of salvage raise revenue above costs. However, it is the good market for the sale of compost, which is in great demand by agriculturists, which makes large scale mechanical composting a feasible venture for private capital in Israel.

The cost of handling raw refuse in the composting plants studied comes to about $4.50 per ton in Tel Aviv and $5.75 per ton in Haifa. In some cases this may be equal to, or only slightly higher than incineration costs. Rogus reported incineration costs to be even higher, based on experience in New York City.[12] In some communities in the United States and in other countries composting may prove, in time to be quite economical if a minimal market for compost can be developed.

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[3] Personal communication from Mr. E. Arditi, Organic-Fertilizer Section, Israel Ministry of Agriculture.

[8] Municipal Incinerator Design, A survey of Engineering Practices Prepared by the Solid Wastes Engineering Section, Committee on Sanitary Engineering Research, A.S.C.E. for the U.S.P.H.S.

[9] Foster, William S., "The Elements of Refuse Collection and Disposal." The American City, Vol 66, June 1955.

[10] Weaver, L. and Harward, J.A., Paper presented at a series of Sanitary-Landfill demonstrations sponsored by the U.S.P.H.S. in 1952.

[12] Rogus, Casimir A., "Incineration," Proceedings, Third Sanitary Engineering Conference, Pittsburgh, November 4, 1961, p. 19

Abstract (continued)

TABLE ONE - GENERAL INFORMATION
ECONOMIC COMPARISON OF GARBAGE COMPOSTING PLANTS IN ISRAEL

	HAIFA	TEL AVIV
1. Population served	75,000	600,000
2. Rated Capacity (raw refuse)	50 tons/day	500 tons/day
3. Quantity raw refuse treated/yr.	15,000 tons	150,000 tons
4. Capital Cost	500,000 IL-$278,000	2,200,000 IL-$1,220,000
5. Capital cost/ton rated capacity	10,000 IL-$5,560	4,400 IL-$2,440
6. Type of refuse	Mixed garbage and rubbish	Mixed garbage and rubbish
7. Quantity of compost	15,000 m^3/yr.	100,000 m^3/yr.
8. Dist. from town center	2 miles	8 miles
9. Type of process		
(1)	Hand and mechanical sorting	Hand and mechanical sorting
(2)	Composting in enclosed revolving cylinder-3 days	Rough grinding (rasping)
(3)	Final screening	Fine grinding and ballistic separation
(4)	Windrow storage	Composting in windrows turned every 3-4 days for 3 weeks
10. Equipment manufacturer	Dano Inc., Denmark	Dorr-Oliver, Holland

Abstract (continued)

TABLE TWO - PRODUCTION COSTS AND REVENUE
ECONOMIC COMPARISON OF GARBAGE COMPOSTING PLANTS IN ISRAEL

	HAIFA		TEL AVIV	
	IL	$	IL	$
Est. Annual Production Cost				
1. Capital expenses (interest and depreciation)	75,000	41,700	365,000	203,500
	(11 men)		(65 men)	
2. Labor	42,000	23,400	264,000	147,000
3. Materials	4,000	2,200	197,000	109,500
4. Electricity and water	9,500	5,300	58,000	32,400
5. Sales promotion, research, and misc.	20,000	11,100	222,000	123,500
6. Maintenance	5,000	2,800	47,000	26,100
TOTAL	155,500	86,500	1,153,000	642,000
Est. Annual Revenue				
1. Sale of compost	135,000	80,500	1,105,000	615,000
2. Salvage	32,000	17,800	230,000	127,500
3. Municipal subsidy	30,000	16,700	145,000	80,500
TOTAL	197,000	115,000	1,480,000	823,000
Net income before taxes	41,500	28,500	327,000	181,000
Rate of return on investment	8.3%/year		14.8%/year	

Abstract (continued)

TABLE THREE - UNIT COSTS AND REVENUE ECONOMIC COMPARISON OF GARBAGE COMPOSTING PLANTS IN ISRAEL

	HAIFA		TEL AVIV	
	IL	$	IL	$
Costs per m^3 compost				
1. Capital expenses	5.00	2.78	3.65	2.04
2. Labor	2.80	1.55	2.64	1.47
3. Operations and maintenance	1.24	.68	3.02	1.68
4. Sales, research, etc.	1.34	.74	2.22	1.23
TOTAL	10.38	5.75	11.53	6.42
Revenue per m^3 compost				
1. Sale of compost	9.00	5.00	11.05*	6.15
2. Salvage	2.14	1.18	2.30	1.28
3. Subsidy	2.00	1.12	1.45	.80
TOTAL	13.14	7.30	14.80	8.23
Net income per m^3 compost	3.06	1.55	3.27	1.81

*95% of compost sold at 9 IL/m^3

5% of compost sold at 50 IL/m^3

Disease/Solid Waste
Abstracts

No. DSW- 289

Author

Ralph Stone and F.R.Bowerman

Title

Incineration and Alternative Refuse

Disposal Processes

Reference

American Society of Civil Engineers

Doc. No.	**Contract No.**	**Date issued**
V.80. No 471		Aug. 1954

Abstract

1. Refuse disposal should be sanitary, convenient, and economical
2. Refuse disposal is influenced by the frequency and method of collection.
3. Transfer stations can be employed for reducing the costs of transporting refuse.
4. Salvage, hog feeding, composting, garbage reduction, landfill, water disposal, and gargage grinding are alternative refuse disposal systems
5. The British were the first to construct high termperature "destructor" plants in the latter part of the 19th century. They developed the incinerator to produce by-products such as clinker for building materials and steam for heat and power. In recent years the British have found sanitary landfill more economica for most refuse disposal.
6. In the U.S. incinerators were originally used to burn garbage As the nation s population increased, incinerators were employed by metropolitan cities to conserve the limited land disposal sites.
7. Approximately 250 U S. cities have used incinerators, the other municipalities are largeley dependent on sanitary landfill
8. Incinerators should be located to satisfy the following factors:

   (a) maximum economy of collection hau , (b) operation in an industrial area to reduce nuisance and promote refuse salvage, (c) two-level topography for minimum construction costs, (d) reduction of atmospheric pollution and (e) convenient ash disposal.

9. American incinerators have made little use of by-products such as heat or clinker Burned tin cans have been salvaged by some U.S. cities.
10. Incineration is a relatively costly refuse disposal process, involving

Descriptors

refuse
disposal
collection
salvage
hog feeding
composting
garbage reduction
landfill
water disposal
garbage grinding
incinerator
garbage
atmospheric pollution
ash disposal
costs
high rate burning

Abstract (continued)

from $2,000 to $5,000 per rated ton of 24 hour burning capacity for construction costs, and ranging from $2 to $5 per ton of refuse burned as actual operating cost

11. U S. incinerators are tending to become more mechanized as labor costs increase
12. Incinerator components include (a) weighing station, (b) unloading facilities, (c) charging, (d) primary drying and burning chambers with mechanical stoker, ash disposal. and forced draft, (e) secondary chamber, (f) flues. stack and particulate matter control devices
13. The percentage of CO_2 concentration in the stack gases can be used as a means of controlling the air to fuel ratio.
14. The particulate matter discharge from an incinerator stack can be controlled by settling, electrostatic precipitation, entrapment, filtering, and other such processes or devices
15. Refractories are important elements in effective operation of an incinerator. Plastic refractory material can be used for repair of exposed surfaces
16. Good laboratory and technical control should be employed to obtain optimum performance from expensive incineration plants.
17. High rate burning, using optimum volume reduction rather than complete oxidation, may be desirable to reduce incineration costs.
18. High rate burning does not completely burn large limbs and other well-insulated refuse but rather flash-burns low density material to minimize the volume of residue for land disposal. Special incineration design is required for successful high rate burning and should include the following: turbulent suspension of the introduced refuse, high temperature burning, continuous feed of refuse and continuous removal of residue, thorough quenching of residue, and final sanitary land burial of the odorous residue
19. The burning process in an incinerator includes drying the refuse, heating to the fire ignition point, and then flame burning in the presence of oxygen supplied by air
20. Examples of Thermodynamic calculations for mass balance and heat energy utilization are given.

Abstract (continued)

TABLE 1

Comparison between Costs for Straight Haul and Transfer and Haul

Cost of One-Way Haul in Refuse Collection Trucks
Hauling Data from Three California Cities

City Designation	Time Spent at Landfill Site (Minutes)	Time Traveling to Landfill and Return (Minutes)	Round-trip in Miles	Minutes per Mile
A	27	23	4.8	4.8
B	8	17	4.2	4.0
C	10	62	24	2.6
Average	15	34	11	3.8

Assume: Average truck load = 2.75 tons
O&M plus amortization - collection truck = $1.25/hour
Labor: 1 driver = 1.50/hour
2 swampers at 1.25/hour = 2.50/hour
5.25/hour = $.0875/minute

Miles to Disposal Site (one-way)	Cost for Haul at $.0875 per Minute	Cost per Ton for 2.75 Ton load	
1	$0.88	$0.32	NOTE: No charge made for time at disposal site as collection truck must also dump at transfer site when using transfer method.
2	1.58	0.58	
3	2.28	0.83	
4	2.89	1.05	
5	3.32	1.21	
10	4.73	1.72	

Cost of One-Way Haul in Transfer Truck or Trailer

Assume: Cost of operating and amortizing transfer station = $0.40/ton
Average transfer truck or trailer load = 15 tons
O&M plus amortization for equipment = $2.50/hour
Labor: 1 driver = 1.50/hour
$4.00/hour = $.0667/min.

Average travel time = 3 minutes per mile (20 MPH)
Average time spent at site = 20 minutes

Miles to Disposal Site (One-Way)	Time for Round Trip (Minutes)	Cost for Haul at $.0667 per Min.	Cost for 20 Min. Period Dumping at Site	Total Cost for Haul and Dumping	Cost per Ton for Haul and Dumping	Cost of Transfer/Ton	Total cost per Ton
1	6	.40	1.35	1.75	0.12	0.40	0.52
2	12	.80	1.35	2.15	0.14	0.40	0.54
3	18	1.20	1.35	2.55	0.17	0.40	0.57
4	24	1.60	1.35	2.95	0.20	0.40	0.6
5	30	2.00	1.35	3.35	0.22	0.40	0.6
10	60	4.00	1.35	5.35	0.36	0.40	0.76
15	90	6.00	1.35	7.35	0.49	0.40	0.89
20	120	8.00	1.35	9.35	0.62	0.40	1.0

Disease/Solid Waste Abstracts

No. DSW- 290

Author Sanitary Engineering Research Laboratory, University of Southern California, Los Angeles, Calif.

Title
Investigation of Leaching of Ash Dumps

Reference California State Water Pollution Control Board

Doc. No.	**Contract No.**	**Date issued**
SWPCB Pub. No. 2, Ch. VI, pgs 79-89		1952

Abstract

Probably the most important contribution of this report is the following table which shows the pounds of the various materials leached per cubic yard from the ashes investigated. by the application of water. Groundwater may be expected to leach an ash dump of its salts and alkalies The precise rate at which such leaching will proceed. while known to be slow, remains a matter of strong conjecture, for undoubtedly the answer lies in the volume of water which will percolate or move through the dump Similarly the net effect of the leach on a groundwater can only be stated in terms of the volume of groundwater receiving the leach, i e , the available dilution

Certainly it may be stated that the use of a site for purposes of incinerator ash disposal constitutes no threat to the groundwater, providing reasonable caution is exercised to prevent direct funneling of the leach into a limited volume of groundwater. such as a well or group of wells.

It is hoped--even anticipated--that the figures presented herein relative to (1) the expected quantities to be leached per cubic foot of ash at flow volumes far in excess of anything possible due to record precipitation or normal groundwater movement and (2) the average quantities of materials originally present in the ash will enable the reader, familiar with his own conditions, to formulate his own opinions relative to ash dump locations.

It appears reasonable to conclude that an ash dump having an initial moisture content of 6 to 10 percent and a depth of 25 feet will admit penetration to the bottom in two years, assuming conditions of heaviest recorded rainfalls such as the 1940-41 season. With conditions of average rainfall existing in this area, it appears that complete penetration would be effected only in a period of four years or more

Descriptors

ashes
groundwater
ash dump
salts
alkalies
dump

Abstract (continued)

QUANTITIES OF LEACHED MATERIAL

	Pounds per cubic yard of ash			
	Lacy Street 12-ft. depth	Beverly Hills	La Loma	Marengo
Sodium	0.974	2.87	0.586	1.28
Potassium	0.274	1.57	0.582	1.22
Calcium	0.484	0.424	0.377	0.299
Magnesium	0.110	0.385	0.368	0.137
Chloride	0.614	5.30	0.202	0.391
Sulfate	3.06	4.59	3.57	4.32
Alkalinity	0.680	1.33	0.686	0.444
Nitrate nitrogen	....	....	....	0.147

No. DSW- 291

Author
S.H. Dawson and W H Dunkley

Title
Pulverized-Fuel Ash Disposal

Reference
Proc. Instn. Mech. Engrs.

Doc. No.	**Contract No.**	**Date issued**
Vol. 176 No. 19		1962

Abstract

Large modern power stations, operating on base load conditions, will produce fly ash with carbon content of less than 5 per cent on average. The average specific gravity of fly ash is approximately 2.0 with a range of 1.8 to 2.4. The bulk dry density is between 35 to 74 lb/ft^3, according to the degree of compaction--a reasonable working figure would be 55-60 lb/ft^3. The specific surface is 2200-3500 cm^2/g--is obtained from electrostatic precipitators preceeded by cyclones as installed in the new large power stations.

The type of plant installed at a power station to handle ash is determined by the method of final disposal. Where areas, such as disused gravel pits or low lying land, are available for ash disposal and are up to a distance of about two miles from the power station, both 'bottom ash' and 'fly ash mixed with water can often be pumped to the point of disposal, and this method can be the cheapest of all for a period of years. For greater distances, up to about six miles, only the fly ash is pumped, the bottom ash being removed from the power station site in vehicles.

Bottom ash collected on the hearth is removed by high-pressure water jets and is discharged into a sluiceway leading to the ash transfer sump: at the sump the ash is crushed and pumped to the disposal area Fly ash collected in the various hoppers is removed by ejectors and discharged via the sluiceway to the transfer sump where it is dealt with in a similar manner to the bottom ash.

The disposal of fly ash over long distances by road transport offers no complete solution to the problem. For the vast quantity to be disposed of from large modern power stations a very large fleet of vehicles would be needed. The optimum scheme of disposal is one that is detailed and seriously projected to cover every ton of refuse that the plant is to produce in its life at any likely rate of production

Descriptors

fuel ash
disposal
fly ash
electrostatic precipitators
bottom ash
road transport
cost
public relations
pits
damp tipping
municipal refuse
rats
utilization

Abstract (continued)

Every disposal scheme has to be looked at from the following angles: (1) Cost: Initial and continuing; (2) Public relations: Here consider the influence of the activities of transport and disposal on the community; and (3) Planning. If all low pits are full in a locality, or if there are a number of small ones dispersed over an area, it will often prove upon analysis over a period of years that damp tripping is the optimum method from the start A combination of municipal refuse with p.f ash, damp tipping, has been operated in one place south of London with good results as to cost and ultimate amenity. The admixture of this ash with town refuse entirely prevents the appearance of rats at the tip.

We must discover new and develop the many known means to reduce disposal costs by utilization.

(i) Chemical composition (less carbon)

	Average, per cent	*Range, per cent*
SiO_2	46·0	(41·0 to 49·0)
Al_2O_3	27·0	(23·0 to 30·0)
Fe_2O_3	11·0	(8·0 to 15·0)
CaO	5·5	(2·0 to 8·0)
MgO	2·5	(1·0 to 4·0)
SO_3	1·5	(0·5 to 2·0)
Alkalis (Na_2O+K_2O)	4·0	(3·0 to 5·0)
Undetermined	2·5	
	100·0	

Disease/Solid Waste Abstracts

No. DSW- 292

Author

Title
New Incinerator Promises Less Smog

Reference
Engineering News-Record

Doc. No.	**Contract No.**	**Date issued**
pp. 47-48		10-11-56

Abstract

Strictest test the unit has had to pass is the particulate-matter test. The incinerator may not discharge more than 0.4 grains per cu ft. of particulate. Highest particulate-matter concentration for the new unit was 0.3 grains per cu. ft. Other tests ran lower.

Ashes falling through the grates are water-sprayed for cooling and dumped into trucks through a hydraulically operated gate.

The water scrubber, or gas washer, includes five horizontal baffles that force the gas in an over-and-under path. At the same time, the gas is subjected to a fine but powerful water spray, which knocks out the particulate matter which would otherwise be emitted as fly ash.

Air pollution--Many cities dispose of combustible rubbish in open burning dumps or as landfill But in the Glendale area, there is no space for land-fill operations--and uncontrolled burning on dumps would add to the already serious smog problem.

Descriptors

incinerator
ashes
gas washer
particulate matter
flyash
air pollution
rubbish
dumps
landfill
smog

Disease/Solid Waste
Abstracts

No. DSW- 293

Author

Dr. Leslie A. Chambers

Title

Where Does Air Pollution Come From?

Reference Proceedings . National Conference on Air Pollution, Nov. 18-20, 1958.

Doc. No.	**Contract No.**	**Date issued**
PHS No. 654, pgs.	34-38	1959

Abstract

There are two general categories of air pollutants with which we must be concerned: (1) those substances which arise directly from industrial, commercial, domestic, transport, or agricultural activity; and (2) those pollutants which do not come ready-formed from primary sources, but instead are products of interaction among primary pollutants under the influence of natural forces in the atmosphere.

Air pollution by primary waste products has presented problems in many places and in many ways. Dusts, smoke, fumes, and liquid droplets obscure the sunlight, interfere with aircraft operations, soil buildings and clothing, may be malodorous, and in some cases (e.g., H_2SO_4 mists) have been alleged to be lethal to plants, animals, and man Gaseous discharges (e.g., sulfur dioxide, carbon monoxide, oxides of nitrogen, hydrogen sulfide) are known to be toxic when present in high enough dosage, inssome cases have objectionable odors, and have such a general history of undesirability that their presence in any significant concentration gives rise to public uneasiness and public health concern.

Metallic fumes and dusts (e.g., of lead, vanadium, arsenic, beryllium, and their compounds) when present, usually are unperceived by the public but have raised serious questions among toxicologists as to the probable physiological effects of chronic low-level exposure Similarly, air-borne compounds of nonmetallic elements, such as fluorine and phosphorous, have not only aroused medical interest, but in at least one case have resulted in a court judgment in favor of a plaintiff alleging impairment of personal health as a result of exposure to fluorides identified with a particular processing plant.

3. Solids, as dusts, smoke, condensed fumes, etc., result from:
    a. Waste incineration at the rate of about 25 pounds per ton burned
    b. Fuel oil combustion at the rate of about 2.5 pounds per 1,000 pounds

Descriptors

air pollution
waste
dusts
smoke
fumes
H_2SO_4
sulfur dioxide
oxides of nitrogen
hydrogen sulfide
toxic
public health
metallic fumes and dusts
lead
vanadium
arsenic
beryllium
chronic
exposure
fluorine
phosphorous
solids
incineration
coal burning
cement
sandblasting
rock crushing
glass
ceramic industries
automobiles

Abstract (Continued)

of oil used.

c. Coal burning--around 200 pounds per ton of fuel
d. Automobile engines--about 0.3 pounds per 1,000 gallons of gasoline used.
e. Diesel engines--about 100 pounds per 1,000 gallons of oil used

Substantial amounts of finely divided solid pollutants are also emitted in extremely variable quantities from ferrous and nonferrous metal refining, processing, manufacturing, and finishing and from such activites as cement manufacture, sandblasting, rock crushing, glass and ceramic industries, and many others. The rates of emission in these cases are related not only to raw material and fuel units, but also to the nature of the individual methods used in processing Indices similar to those above are available but necessarily have limited applicability.

Disease/Solid Waste
Abstracts

No. **DSW-** 294

Author

Dr. James P Dixon

Title

What Does Air Pollution Do to Humans?

Reference Proceedings. National Conference on Air Pollution, Nov. 18-20, 1958

Doc. No. **Contract No.** **Date issued**
PHS. No. 654, pgs. 39-41 1959

Abstract

There is clear evidence that certain types of air pollutants, if exposure to them is extended over long periods of time, can cause chronic bronchitis. This is a clinical entity that is well recognized in Great Britain; in a recent appriasal there, the disease ranked third among causes of death and first as a cause of work-days lost due to illness But here again, the exact mechanism of causation is not clearly understood, although research in this field is continuing. At the moment it is believed that the air pollutants cause a basic disability in the respiratory system.

It is a well demonstrated fact that the death rates for certain diseases are higher in urban than in nonurban communities. On the list of such diseases, we find arteriosclerotic and other heart conditions and cancer of the stomach and esophagus and of the lungs. Because pollution of the air is more intense in urban areas [illegible] is proper to consder that air pollution may play a role in this increased mortality.

Throughout the industrialized world, lung cancer has been showing a striking increase as a cause of death. Much research has been directed to a study of the cause for this increase. Cigarette smoking has been strongly implicated as a contributory cause, but even after correcting mortality rates for lung cancer among urban dwellers for the effects of their smoking habits, the incidence of lung cancer still remains significantly higher in urban than in rural areas. There have been observations indicating that there are a number of pollutants in the air of some communities that can produce cancer in experimental animals But information of this type does not verify a cause and effect relationship between air pollution and lung cancer, although it does create an insistent demand that the possibility of such a relationship be thoroughly explored. It is clear that, under some circumstances, acute air pollution can cause death among older persons and can cause serious illness to others. At least in the instance of chronic bronchitis there is a direct relation-

Descriptors

air pollution
air pollutants
chronic bronchitis
research
arteriosclerotic
heart conditions
cancer
lung cancer
public health
hazards

Abstract (Continued)

ship between air pollution and a specific disease.

The field of public health throughout its entire history has frequently had to operate from generalizations and has developed control measures for diseases even when the specific etiology of a disease was not known. From the point of view of health protection, therefore, our present state of knowledge is sufficient to stimulate a fundamental concern about the relationship of air pollution and health.

Disease/Solid Waste
Abstracts

No. DSW- 295

Author

Dr. Rolf Eliassen

Title

Domestic and Municipal Sources of

Air Pollution

Reference Proceedings. National Conference on Air pollution, Nov. 18-20, 1958

Doc. No.	**Contract No.**	**Date issued**
PHS. No. 654, pgs. 132-140		1959

Abstract

The major contributions to air pollution from domestic sources are the products of combustion from space heating and refuse incineration. Municipal sources are identified with construction activities, with the operation of sewers and sewage treatment plants, and with the collection and disposal of refuse. Refuse disposal is the major source of air pollution from municipal activities.

Significant contributions to the pollution of the ambient atmosphere of a metropolitan area are made from domestic and municipal activities, particularly space heating and refuse disposal. The relative importance of these sources in the overall picture increases with the use of coal for heating and open burning of refuse and decreases markedly as more homes and apartments use gas and oil for heating and destroy or dispose of refuse by controlled methods. Two hypothetical cases have been presented--one in which domestic and municipal sources were responsible for 32 and 7 percent of the area's total air pollution.

Descriptors

Air pollution
refuse
incineration
collection
disposal
municipal refuse

Abstract (continued)

Table I.—*Pounds of contaminants discharged daily from domestic sources in a metropolitan area of 100,000 persons*

Principal contaminants	Pounds per day per 100,000 persons using each category of heating and refuse disposal					
	Fuel—Domestic Heating			Domestic incineration		
	Coal	Oil	Gas	Backyard burning	Household incinerator	Apartment incinerator
SO_x	42, 000	17, 000	0. 4	180	1	12
NO_x	8, 000	6, 000	6	90	1, 150	30
H_2S	1, 000	500	0. 1	---	-----	24
NH_3	2, 000	800	0. 3	345	-----	24
HCl	2, 000	500	0. 3	---	-----	--
Aldehydes	2, 000	800	1	600	8, 400	72
Organics	20, 000	4, 000	1	42, 000	12, 000	1, 800
Organic acids	30, 000	12, 000	1	225	1, 900	4, 800
Solids	200, 000	800	0. 1	3, 400	16, 500	4, 000
Total of above categories	307, 000	42, 400	10	46, 800	40, 000	10, 700

Notes:
SO_x—oxides of sulfur—SO_2 and SO_3.
NO_x—oxides of nitrogen.
Aldehydes measured as formaldehyde.
Organic acids measured as acetic acid.
Total includes only above categories and does not imply total contamination in the ambient atmosphere.

Table II. *Pounds of contaminants discharged daily from municipal sources in a metropolitan area of 100,000 persons using various refuse disposal methods*

Principal contaminants	Pounds per day per 100,000 persons using each category of refuse disposal		
	Incineration	Burning dumps	Sanitary land-fill
SO_x	290	180	
NO_x	320	90	
H_2S	---	---	Trace.
NH_3	45	345	Trace.
Aldehydes	168	600	------
Organics	210	42, 000	Trace.
Organic acids	90	225	------
Solids	3, 450	7, 000	Variable.*
Total of above categories	4, 570	50, 400	Low.

*Depends on amount of ashes being placed and amount of dust in cover material. Can be controlled.

Abstract (continued)

Table III.—*Comparison of air pollution contributions from domestic and municipal sources with total air pollution potential of metropolitan areas*

Contaminant	Pounds per day per 100,000 persons			Percent of total contaminants	
	Total metropolitan activities	Domestic and municipal sources			
		Case I	Case II	Case I	Case II
SO_2	62, 840	20, 347	2, 635	32	4
NO_2	34, 240	4, 480	1, 462	13	4
H_2S	4, 040	5, 050	105	12	2
NH_3	2, 782	1, 241	201	45	7
Aldehydes	3, 620	1, 456	309	40	9
Organics	129, 400	42, 760	1, 329	33	10
Organic acids	28, 720	15, 540	3, 433	54	12
Solid particulates	337, 200	85, 120	3, 720	25	11
Total of above categories	603, 000	172, 000	13, 200	[1] 32	[1] 7

[1] Average of percentages of each category.

Disease/Solid Waste
Abstracts

No. DSW- 296

Author

S. Smith Griswold, et al

Title
Industrial Sources of Air Pollution
(1)--Petroleum Refineries

Reference Proceedings. National Conference on Air Pollution, Nov. 18-20, 1958

Doc. No.	**Contract No.**	**Date issued**
PHS No. 654, pgs. 140-146		1959

Abstract

Thus, petroleum refineries must be viewed as major potential sources of air contamination. The pollutants derived from their operation represent a broad spectrum, including dusts, fumes, smoke, and the smog-reacting hydrocarbons. Since a modern petroleum refinery is an extremely complex system of processing units, the control of potential air-pollution sources is both difficult and expensive. Pollution leakage can occur from hundreds, if not thousands, of sources in a refinery. Every pump gland and pipe fitting must be viewed as a possible, of only a small, source of air contamination.

Another important source of hydrocarbon emissions which is controlled by regulation is the oil-water separator. Loading racks are another source of hydrocarbon emissions for which regulations now exist Other sources of hydrocarbon emissions in refineries include leakage from valves, pumps, air blowing of stocks, blowdown systems, pipe-line blind changing, and compressor engine exhausts. Operations such as shutting down equipment for repairs may give rise to hydrocarbon emissions. These emissions are usually reduced to low levels by venting to recovery systems before opening vessels for maintenance work.

Emissions of contaminants other than hydrocarbons, such as oxides of nitrogen, sulfur dioxide, and sulfur trioxide, arise mainly from combustion sources. Sulfur dioxide has been controlled to the extent of over 600 tons daily in Los Angeles County by removing hydrogen sulfide from refinery gases before they are used as fuel.

Emissions of smoke from boilers and heaters can be quite readily controlled by use of proper equipment and operational procedures It is now extremely rare to see smoke issuing from a refinery stack. In conclusion, there are 18 oil refineries in Los Angeles County, with a total daily throughput capacity of over 700,000 barrels

Descriptors

petroleum refineries
air contamination
dusts
fumes
smoke
hydrocarbons
sulfur dioxide
oxides of nitrogen
contaminants

Abstract (continued)

of crude oil. These refineries emit daily to the atmosphere approximately 100 tons of hydrocarbons, 150 tons of sulfur dioxide, 60 tons of oxides of nitrogen, and lesser amounts of other contaminants.

The total average daily emissions from the oil refineries in Los Angeles County were shown to be as follows:

	With controls
Hydrocarbons	103 tons
Oxides of nitrogen	56
Sulfur dioxide	145
Particulate matter	10
Sulfur trioxide	5
Ammonia	5
Aldehydes	5
Organic acids	5
Total	334

Assuming that none of the potential pollution sources were curbed, contaminant emissions would total as follows:

Hydrocarbons	800 tons
Oxides of nitrogen	56
Sulfur dioxide	745
Particulate matter	100
Sulfur trioxide	25
Ammonia	5
Aldehydes	5
Organic acids	5
Total	1,741

Disease/Solid Waste Abstracts

No. **DSW-** 297

Author

Dr. Arie J. Haagen-Smit and W. L. Chadwick

Title Industrial Sources of Air Pollution (2)--Electric Power Plants (Gas and Oil Fuels)

Reference

Proceedings. National Conference on Air Pollution. Nov. 18-20, 1958

Doc. No.	**Contract No.**	**Date issued**
PHS No. 654, pgs. 146-155		1959

Abstract

Particulates from fuel oil combustion are microscopic in dimension, and the quantities produced are small when compared with those produced by burning the better coals. The order of size is about 0.4 micron. The amounts of ash in fuel oils vary from about 0.05 percent to 0.15 percent by weight. Proved devices to remove such particulates were not available. Mechanical collector-electrostatic precipitator combinations had, of course, been developed, which are effective in removing the heavier fly ash particulates which are present in discharges from coal-burning plants. Such collectors did not appear suitable for the particulates and for the low loadings in oil fire effluents. These loadings show total particulates of about 75 pounds per hour from a 175 MW unit at full load

After a test and development program which required more than a year, at a cost of approximately $500,000, the design criteria for sull-scale precipitators for use on fuel oil effluents were established. These criteria indicated that about 90 percent of the loading, of which more than 90 percent is below 0.5 micron, could probably be satisfactorily removed.

Descriptors

air pollution
gas and oil fuels
particulates
fuel oil
mechanical collector
electrostatic precipitator
fly ash
industrial

Disease/Solid Waste Abstracts

No. DSW- 298

Author
Arthur A. Orning

Title
Industrial Sources of Air Pollution (3)--
Electric Power Plants (Coal Fuel)

Reference
Proceedings..National Conference on Air Pollution, Nov. 18-20, 1958

Doc. No.	Contract No.	Date issued
PHS No. 654, pgs. 155-161		1959

Abstract

To approximate total dust emission we may assume, for lack of better knowledge, that 10 percent of the ash in the coal will appear as dust entering the atmosphere. At present, based on this assumption, total dust emission for the United States from electric power production varies from about 4,000 tons per day in the summer to 5,000 tons per day in the winter. The emission in any given area will depend upon industrial concentration and local control of air pollution.

The dust may contain 10 percent or more of carbon, but demands for more efficient power production have pushed down and will continue to push down this percentage. The ash is composed primarily of oxides, complex silicates and aluminates of iron, calcium and magnesium with small percentages or traces of sodium, potassium, chlorine, phosphorus, sulfur, and other elements. Particle-size analyses have shown 50 percent by weight to be finer than 10 micorns and 90 percent finer than 30 microns. A large percentage of the dust particles is spherical, but some are sharp and angular, showing no sign of fusion.

Descriptors

air pollution
coal fuel
dust
ash
carbon
oxides
silicates
aluminates
sodium
potassium
chlorine
phosphorus,
sulfur

Disease/Solid Waste
Abstracts

No. DSW- 299

Author

Thomas C. Wurts

Title

Industrial Sources of Air Pollution (4)--

Metallurgical

Reference

Proceedings .National Conference on Air Pollution, Nov. 18-20, 1958

Doc. No.	Contract No.	Date issued
PHS No. 654, pgs. 161-164		1959

Abstract

A very careful analysis of all of the various pollutants resulting from steel mill operations I think conclusively proves that no health hazards result even under severe inversion conditions.

Descriptors

air pollution
metallurgical
pollutants
steel mill operations
health

Disease/Solid Waste
Abstracts

No. DSW- 300

Author

Bernard Greenberg

Title

Persistence of Bacteria in the Developmental Stage of the Housefly

Reference American Journal of Tropical Medicine and Hygiene

Doc. No.	**Contract No.**	**Date issued**
V.8, pgs. 412-622		1959

Abstract II. Quantative Study of the Host-Contaminant Relationship in Flies Breeding under Natural Conditions

The transmission of Salmonella typhi or Shigella flexneri from the larva to the adult housefly is consistently unseccessful if the pathogen is introduced into a contaminated larval medium. Under the same conditions, limited transmission occurs with an organism such as Salmonella enteritidis.

The fly-breeding media surveyed in this study were laboratory CSMA, human feces, garbage and horse manure. The human feces were located in a privy built level with the ground. A garbage dump supported enormous populations of blowflies but relatively few houseflies. A considerable number of housefly larvae were located within some empty shrimp cartons buried in a pile of wood shavings. The horse manure was piled daily in the yard of a riding academy and represented an accumulation of considerable size and age. Some flies retained only a single species of bacteria whereas the majority of flies harbored an assortment of species. These species are widely distributed saprophytes present in the feed and feces of horses and other animals. The majority have often been isolated from the housefly itself and have come to be considered its normal flora. The inability or limited ability of the pathogens to propagate under competitive conditions in the various larval media likewise prevents or limits their retention by the host.

Topley and Fielden found that S. typhi, Salmonella paratyphi A, Shigella dysenteriae and S. Flexneri could not be recovered in the inital subculturing which occurred a few days after the organisms were inocculated into the medium. Freter[2] demonstrated, in vivo the inhibition of S. Flexneri and Vibrio comma by the normal enteric flora of mice and guinea pigs, and also by a streptomycin-resistent E. coli. It appears that enteric pathogens are destroyed in the very environment required by maggots for their development.

Descriptors

- bacteria
- housefly
- host-contaminant relationship
- fly-breeding media
- human faces
- garbage
- horse manure.
- Salmonella typhi
- Shigella flexneri
- Salmonella enteritidis
- Leptospira
- Toxoplasma
- salmonellosis
- dosage delivery
- dise
- S. pullorum
- bacteremia

Abstract (continued)

Summary: Mature maggots support populations of 10^7 bacteria. During the prepupal stage, the count falls to 10^5, and 10^6. At the commencement of pupation counts generally range from 10^4 to 10^5, and this range is maintained during metamorphosis. The majority of emerging flies retain 10^2 or 10^3 bacteria, whereas some are sterile and others have 10^6. Thus two declires consistently appear in the survival pattern: in the prepupa and the newly emerged adult.

Single-species infection with Shigella or Salmonella, dual infection and infection with a multiple saprophytic flora exhibit a pattern of bacterial survival which is essentially similar in all cases. On the basis of the evidence presented in this and the preceding study, it is considered doubtful that the normal flora are better suited than the pathogens for survival in the gut of the developing fly.

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[2] Freter, R., 1956. Experimental enteric *Shigella* and Vibric infections in mice and guinea pigs. *J. Exper. Med. 104:411-418*.

III. Quantitative Distribution in Prepupae and Pupae

Wolman[2] administered typhoid and dysentery organisms to aseptically reared housefly larvae but was uable to recover these organisms from adults. At the height of its growth, the maggot migrates from the moist, fermenting portions to the dry, crusted upper strata of the larval medium. (This, at least, is the behavior of prepupae in the laboratory. Under natural conditions, they often migrate down through the manure to the cooler, damper soil below.) Here it wanders for about 24 hours, presumably without feeding. At the end of a 1-day fast, the maggots have lost most of their flora, final counts being within a range similar to the range of counts typically observed in prepupae. The hemolymph of most maggots and prepupae is sterile (Table 1). It is therefore safe to assume that the larva's gut is an effective barrier to routine systemic invasion by the microorganisms inhabiting it. The guts of 2- and 3-day-old pupae retain relatively few bacteria and, in a few cases, are sterile. Controls consisting of undissected pupae of similar age have typical counts near 10^5. It seems likely that the primary causes for bacterial decimation in the housefly prepupa are mechanical ones: curtailed feeding and continued elimipation. The fly emerges with a count near 10^2 from a puparium containing about 10^5 bacteria.

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[2] Wollman, E., 1921. Le Role des mouches dans le transport de germes pathogenes etudie par la technique des elevages aseptiques. *Compt. Rend. Hebdom. Seances Acad. Sci. Paris, 172:298-301*.

IV. Infectivity of the Newly Emerged Adult.

Typical associates of newly emerged houseflies are *Proteus*, *Pseudomonas* and various coliforms.[2,10,11.] There is justification for categorizing them as potentil human pathogens because of their increasing implication in diarrheal diseases, especially of infants. Certain of the true pathogens, e.g., *S. Enteritidis* and *S. paratyphi B,* may also be present in the adult, but their numbers would probably

Abstract (continued)

be quite low, considering the relatively low counts of most newly emerged flies. The studies of McCullough and Eisel[12] on experimental human salmonellosis indicate the magnitude of the dose necessary to produce symtoms (minimum 10^5, average about 10^6 or 10^7 organisms). On the basis of dosage delivery, the risk of human infection from such a fly is probably slight.[13] Another possible means of infection in animals is suggested by the recovery of viable *Salmonella* in flies 7 days after they had been killed with DDT.[15] Bacteremia in muscoid flies infected with human pathogens is an unusual phenomenon and it should be emphasized that successful transmission of pathogens is more often the exception than the rule when normal contamination of the larval medium is permitted. This has been shown for polio and other viruses;[17,18] for *S. pullorum*;[19] for *S. typhi* and *Sh. flexneri*;[1] for several species of Leptospira;[20] and for Toxoplasma.[21]

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Disease/Solid Waste
Abstracts

No. DSW- 301

Author

John W. Kilpatrick and H.F. Schoof

Title

Interrelationship of Water and Hermetia Illucens Breeding to Musca Domestica Production in Human Excrement

Reference

Am. Jrl. of Tropical Med. & Hyg.

Doc. No.	**Contract No.**	**Date issued**
V.8, p.597-602		1959

Abstract

Schoof and Siverly (1954) and Kilpatrick and Bogue (1956) demonstrated in Arizona and Texas, respectively, that house fly production from pit privies was increased when the excreta were treated with insecticides, particularly dieldrin. Subsequent studies in Chatham County, Georgia (Kilpatrick and Schoof, 1956) showed that in 100 untreated privies, house flies represented a monthly maximum of only 6 per cent of the total specimens collected. In contrast, the production of house flies during July, August, and September, 1954 from privies treated with dieldrin represented more than 70 per cent of the total emergence. The average emergence per untreated privy during June through September usually was less than 30 house flies, versus an average of 254-1946 specimens for the treated structure. Chlordane, BHC, and aldrin applications augmented house fly production, but DDT apparently did not exert a similar influence.

Summary. Bilogical studies conducted on house fly breeding in privies in Chatham County, Georgia, during the period 1955-58, have indicated that:

1. In untreated privies, few Musca domestica are produced, but treatment of privies with dieldrin, BHC, or chlordane greatly increased the house fly production therein. DDT, malathion, and Diazinon showed little or not effect on M. Domestica propagation.

2. Implants of eggs from resistant house fly strains in treated privies produced 16 to 258 times as many adults as did similar implants in untreated privies.

3. Untreated privies were characterized by heavy infestations of the soldier fly, Hermetia illucens, and by semiliquid excreta. In contrast, treated privies showed few H. Illucens larvae and the media were of a semisolid nature.

4. Mainipulation of the water content of the media by drainage or the addition of sawdust or dirt caused an increase in house fly breeding similar to that achieved

Descriptors

water
Hermetia illucens
Musca domestica
human excrement
insecticides
dieldrin
Chlordane
BHC
aldrin
DDT
soldier fly

Abstract (continued)

by dieldrin treatments.

5. The increased house fly production in treated privies is a result of a change in the physical consistency of the human excreta brought about by the reduction of H. illucens breeding which had been instrumental in maintaining the media in a semiliquid condition. House fly resistance plays a definite role in the phenomenon, by permitting this species to survive contact with toxicants which are highly lethal to H. illucens. No evidence was found to show that the resistance influenced or stimulated the biotic potential of M. Domestica.

Disease/Solid Waste
Abstracts

No. DSW- 302

Author

A. B. Dunne and B.C. Cantab.

Title

Typhoid Fever in South Africa:

Its Cause and Prevention

Reference

British Med. Jrl. p 622

Doc. No.	Contract No.	Date issued
		3-8-02

Abstract

The plague of flies which was present during the epidemic of enteric at Bloemfontein in 1900 left a deep impression on my mind, and, as far as I can ascertain from published reports, on the minds of all who had experience on that occasion. Nothing was more noticeable than the fall in the admissions from enteric fever coincident with the killing off of the flies on the advent of the cold nights in May and June

Descriptors

Disease/Solid Waste
Abstracts

No. DSW- 303

Author

E. Klein

Title

"Flies" as Carriers of the Bacillus Typhosus

Reference

Br. Med. Journal p.50-51

Doc. No.	Contract No.	Date issued
		10-17-08

Abstract

On September 4th I received from Dr. Heywood Wilshaw a box contining a large number of flies. Twelve of these (living) were minced in a sterile dish with 1/2 c.cm. of sterile salt solution. The whole of the resulting turbid fluid was used for cultures: (1) to demonstrate the presence of *B. coli communis*; (2) to search for the presence of microbes belonging to the typhoid group. In all of these cultures copious *B. coli communis* was easily identified.

The conclusion that can be justly drawn from these experiments is that the flies examined contained besides a great number of *B. coli communis* also in limited numbers a species of microbe which is not distinguishable from *B. typhosus*, the insignificant difference just stated may be a difference due to different race. The actual demonstration of *B. typhosus* in the flies lends, therefore, strong support to the conclusion arrived at from the epidemiological data--namely, that the contagium in the cases of enteric fever dealt with in Dr. Wilsaw's report was conveyed by the flies of the locality.

Descriptors

flies
carriers
bacillus typhosus
B. coli communis
enteric fever

Disease/Solid Waste Abstracts

No. DSW- 304

Author

Francis Metcalf Root

Title

Experiments on the Carriage of Intestinal Protozoa of Man by Flies

Reference

Am. Journal of Hygiene

Doc. No.	Contract No.	Date issued
V. 1, No. 2, pgs. 131-2, 139, 150-3		Mar. 1921

Abstract

The danger to the public health arising from the pernicious activities of the common housefly and its relatives is now well known. Numerous experiements, ably summarized by Graham-Smith (1914), have shown conclusively that flies may be important factors in the spread of such diseases as typhoid fever, paratyphoid, choler and infantile diarrhea in which the bacteria which cause the disease are found in large numbers in the feces of the person affected. These experiments have also shown, in great detail, how long these bacteria remain infective when carried by flies.

The first attempts to test by experiment the possibility of the distribution of cysts of intestinal protozoa by flies occurred in 1913. Stiles and Keister (1913) proved that houseflies could carry "Lamblia spores" (the cysts of *Giardia intestinalis*)on their outer surface, and pointed out that, from epidemiological considerations, the carriage of cysts by flies from open privies to kitchens was almost undoubtedly the main avenue of infection in the part of the United States in which they were working. Kuenen and Swellengrebel (1913), in Java, carried on the first experiments on the carriage of cysts of intestinal amoebae by flies.

Turning to the practical aspects of the work, it is hoped that these results may be of interest to men working in the field on the general subject of soil pollution, first, because they emphasize again the importance of flies as carriers of disease-producing organisms from human feces to human food, and second, because they define more exactly the limits of such carriage, in so far as the cysts of intestinal protozoa are concerned. From this point of view, the relation of flies to the spread of intestinal protozoan infections may be stated as follows:

Descriptors

housefly
typhoid fever
paratyphoid
cholera
infantile diarrhea
Protozoa
Giardia intestinalis
soil pollution
intestinal protozoan infections
cysts
Giardia
amoebae
Chilomastix

Abstract (continued)

Free forms	1 hour or less
Cysts of Giardia	16 hours.
Cysts of amoebae	40 to 50 hours
Cysts of Chilomastix	80 hours.

These experiments also show that half of the cysts contained in the fly will be alive 7 hours after feeding in the case of Giardia, 14-16 hours after feeding for the amoebae and 36 hours after feeding for Chilomastix. The earlier hours, when a large proportion of the cysts are still living, must be far more dangerous than later hours.

Further, if a fly contaning cysts is drowned in water, milk, soup, or other liquid food, the cysts will live still longer, about a week, and there seems to be a possibility that human beings might be infected by swallowing such drowned flies.

Disease/Solid Waste
Abstracts

No. DSW- 305

Author

Maurice C. Hall

Title

Arthropods as Intermediate Host of
Helminths

Reference Smithsonian Institution (Misc. Coll.); Pub. 3024

Doc. No.	Contract No.	Date issued
V.81, No. 15, p.1,2,64,69-72		1929

Abstract

The phylum Arthropoda contains numerous forms which serve as intermediate hosts of many parasitic worms, including nematodes, acanthocephalids, vlukes, and tapeworms. These arthropods constitute the food supply, wholly or in part, for so many higher animals, especially for such forms as fish, many amphibians, some repiles, numberous birds, and some mammals. Many insects feed on or breed in manure and consequently are exposed to infection from the eggs or larvae of worms parasitic in the hosts responsible for the manure.

There are 48 species in the Cestoda which have arthropods as intermediate hosts and for which we know the primary hosts; there are 22 larval forms in addition for which the primary hosts are not known.

There are 37 species in the Trematoda which have arthropods as int3rmediate hosts and for which we know the primary hosts; there are 27 larval forms in addition for which the primary hosts are not known.

There are 49 species in the Nematoda which have arthropods as intermediate hosts and for which we know the primary hosts; there are 12 larval forms in addition for which the primary hosts are unknown.

There are 9 species in the Acanthocephala which have arthropods as intermediate hosts and for which we know the primary hosts.

There are altogether 143 species of worms parasitic in vertebrates which have arthropods as intermediate hosts and for which the primary hosts are known; there are 61 larval forms in addition for which the primary host is unknown.

In the Insecta there are 25 species which serve as intermediate hosts for Cestoda, 46 for Trematoda, 122 for Nematoda, and 15 for Acanthocephala. The Insecta are far in the lead as regards numer of species known to serve as intermediate hosts for parasitic worms.

Descriptors

arthropods
hosts
helminths
Cestoda
Trematoda
Nematoda
Insecta

Abstract (continued)

The total number of arthropod species listed here as intermediate hosts for the worm groups involved is 271.

Prophylactic measures directed against heteroxenous worms call for control measures for intermediate hosts.

Finding that one arthropod is an intermediate host does not settle the problem of a life history of a worm. The worm may have a score of intermediate hosts, and the most important one may not be an arthropod.

Disease/Solid Waste
Abstracts

No. DSW- 306

Author

E. Harold Hinman

Title

Hereditary Transmission of Infections Through Arthropods

Reference

Am. Journal of Tropical Medicine

Doc. No.	Contract No.	Date issued
V.13, pgs. 415-423		1933

Abstract **Historical**

Smith and Kilbourne (1893) showed that Texas fever of cattle was transmitted by the tick, Boophilus annulatus and the infection was found to be hereditary in the tick. Since that time various human parasites have been proved capable of transmissal through the egg of the arthropod host.

Parker (1923) showed that infected Haemaphysalis leporis-palustris (rabbit tick) may transmit the virus of Rocky Mountain spotted fever to the egg as in the case of the fever tick. While the rabbit tick does not feed on man this hereditary transmission is important in the spread of the disease among rodents.

Those arthropods which exhibit a gradual type of metamorphosis, passing through several molts would seem less liable to lose an infection, contracted from the egg, than insects having a pupal stage. It is during this pupal instar, when an almost complete internal regeneration of tissues and organs takes place, that the insect would be more likely to lose the microorganisms than during a larval molt where only the external chitinized parts are shed.

A consideration of the types of etiological agents, which may be transmitted from one generation of arthropods to the next, reveals representatives of the following groups: bacteria, filterable viruses, rickettsiae, spirochetes and protozoa.

Summary: A brief literature resume of the hereditary transmission of human infections by arthropods is presented. This mechanism of transmission is of considerable importance in the epidemiology of these diseases and in a few instances if probably the normal method by which the parasite reaches man. It is also of great significance in the propagation and maintenance among animal reservoirs. Attention is called to the occasional presence of microorganisms within the ova of mosquitoes. While as yet there is no experimental proof that

Descriptors

hereditary
transmission
infections
arthropods
human parasites

Abstract (continued)

the etiological agent of any human infection may be hereditarily passed through the mosquito, additional research may force us to change our opinions on this subject.

Disease/Solid Waste
Abstracts

No. DSW- 307

Author

Roy W. Chamberlain and Rober K. Sikes

Title

Laboratory Investigations on the Role of Bird Mites in the Transmission of Eastern and Western Equine Encephalitis

Reference

Am. Journal of Tropical Medicine & Hygiene

Doc. No.	Contract No.	Date issued
V. 4, pgs. 106-18		1955

Abstract

Summary: In view of the low susceptibility of these three species of mites to EEE and WEE infection, it is concluded that any role they might play in perpetuating these viruses in nature must be minor.

Descriptors

transmission
bird mites
eastern and western equine encephalitis
Dermanyssus gallinae, Bdellonyssus bursa, and B. sylviarum

Disease/Solid Waste
Abstracts

No. DSW- 308

Author S. Edward Sulkin, Charles L. Wisseman, Jr., Ernest M. Izumi and Christine Zarafonetis

Title

Mites as Possible Vectors or Reservoirs of Equine Encephalomyelitis in Texas

Reference

Am. Journal of Tropical Medicine & Hygiene

Doc. No.	Contract No.	Date issued
V. 4, pgs.119-35		1955

Abstract

The present report summarizes the results of field and laboratory studies designed to determine the role of mites as possible vectors or reservoirs of Western equine encephalomyelitis. It is concluded from these studies that although occasionally chicken mites or wild bird mites are found to be naturally infected with this virus they play no essential role in the epidemiology of the disease. The demonstration of the Western equine virus in chicken mites or in wild bird mites may be significant only as an indication that they have recently fed on infected chickens or wild birds.

Descriptors
mites
vectors
Western equine encephalomyelitis
chicken mites
wild bird mites
epidemiology

Disease/Solid Waste
Abstracts

No. DSW- 309

Author

W. D. Hunter

Title

American Interest in Entomology

Reference

Journal of Economic Entomology

Doc. No.	Contract No.	Date issued
V. 6, pgs. 27-39		Feb. 1913

Abstract

We quote from Dr. H. R. Carter, "Yet Gorgas now believes, and I think all who participated in the work here concur with him unreservedly, that his success in Havana and on the Isthmus was due to the war waged against the Stegomyia directly, by the destruction of their breeding places, undertaken as an adjuvant to the isolation of the sick, rather than to that isolation itself; to the control of the insect rather than of the human host.

As Doctor Carter points out, the elimination of the disease by the management of the human host failed because that host could not be controlled. We believe that the experience with yellow fever will be duplicated in practically all insect-borne diseases. Nothing short of the suppression of the insect host will yield satisfactory results. The recent work of Celli in Italy in which medication with quinine rather than Anopheles destruction is the basis, is the exception.

Descriptors

insect-borne diseases
insect host
Anopheles

Disease/Solid Waste
Abstracts

No. DSW- 310

Author

H. Tsuchiya

Title

Experimental Amebiasis in Rats with Cysts of Human Carriers with Especial Reference to a Probable Mechanism Involved.

Reference

Am. Jrl. of Tropical Medecine

Doc. No.	Contract No.	Date issued
V. 19,151-2,158-162		1959

Abstract

On the basis of these findings together with a comparative rarity of rodent infection in nature, one may be led to consider rats as one of the incidental rather than natural hosts in amebic infections. However, since cross infection between man and rats was apparently possible, rats may be conceived as a reservoir for Endamoeba histolytica.

Descriptors

rodent infection
reservoir
Endamoeba histolytica
amebiasis
rats
cysts
human carriers

Disease/Solid Waste Abstracts

No. DSW- 311

Author

Ellis Herndon Hudson

Title

The Role of the Reservoir Host in Tropical Disease

Reference

Am. Jrl. of Tropical Medicine

Doc. No.	**Contract No.**	**Date issued**
V. 24, pgs. 125-30		1944

Abstract

A reservoir host is a lower animal which shares some disease or parasite with man. The infection or the parasite is equally at home in man and the reservoir, is biologically indistinguishable in either case, and may oscillate quite contentedly from one to the other as environmental circumstances open the way. Such is P. pestis in relation to rat and man, and E. granulosus in relation to sheep and man.

It is necessary to distinguish precisely between a vector and a reservoir host. It is true that in some cases, such as the ticks of relapsing fever and certain of the rickettsial diseases, the vector may also constitute a true reservoir. Usually, however, the short life-span of the vector, his inability to transmit the disease to his offspring, and his primary function of transport, suffice to exclude him from the reservoir status.

Hall once wrote that man acquires the diseases of lower animals when he "cuts across the lines of communication" utilized by the parasites in their movement from one to another customary host. There are three ways in which man may thus cut across nature's lines of communication. He may ingest food or water contaminated with parasites or their eggs on their way to lower animals; he may inadvertently expose himself to the bites of vectors similarly seeking their usual victims among the lower animals; or he may acquire diseases from reservoir animals by contact or common environment.

From the standpoint of zoological classification, most parasites are comprised within four rather arbitrary groups, the helminths, the protozoa (including the spirochetes), the bacteria (including the molds), and the viruses (including the rickettsias). These four groups are presented herewith in four tables which give

Descriptors

reservoir host
tropical disease
disease
parasite
man
vector
helminths
protozoa
spirochetes
bacteria
viruses
rickettsias
tularemia
sylvatic plague
spotted fever
endemic typhus
leptospirosis
equine encephalomyelitis

Abstract (continued)

the reservoir hosts of each parasite. Each group is subdivded in turn into three divisions on the basis of the parasite's avenue of entrance into man, whether by ingestion, common vector, or common environment.

In a fifth table are listed the scientific and common names and the reservoir hosts of certain insects which, in adult or larval form, attack man when he intrudes between them and their normal hosts among the lower animals. The helminths which we share with reservoirs, we acquire most by the ingestion route, and very few by vector or contact. Most protozoans spill over from reservoirs to man by way of vectors, and hardly any by ingestion or contact. Bacterial parasites reach man by all three routes. Of those virus and rickettsial diseases, however, which invade man from reservoirs, most employ vectors, a few are acquired by contact, and none at all through ingestion.

Let us now compare temperate and tropical zone medicine with respect to the role of the reservoir host. None of these constitutes a grave menace to our national health. The picture is different, however, when we turn to the tropical regions of the earth and to the less highly organized countries of the temperate zone. Here are to be found of course the infections indigenous to man, but there is a marked reduction in the toll of degenerative disease and a striking increase in the number of diseases drawn from animal reservoirs. The animal reservoir host plays a prime role in tropical medicine.

Disease/Solid Waste
Abstracts

No. DSW- 312

Author

H. L. Trembley and F. C. Bishopp

Title

Distribution and Hosts of Some Fleas of Economic Importance

Reference

Jrl. of Economic Entomology

Doc. No.	Contract No.	Date issued
V.33, pgs. 701-3		1940

Abstract

Xenopsylla cheopis (Rothsch).--The oriental rat flea is not a general household pest, but it is important because it is found on domestic rats and is a vector of bubonic plague. This flea was reported on August 10, 1938 (Bishopp No. 28064), as infesting an office building in Youngstown, Ohio, where it was "biting the men working there and causing considerable discomfot." In Nashville, Tenn., a male and female *Xenopsylla cheopis* were submitted by H. E. Meleney (Bishopp No. 28684) from rats captured in a grain store in the city near the Cumberland River in March 1938. To the writer's knowledge these were the first oriental rat fleas reported from Tennessee since 1908, when the Surgeon General of the United States Public Health and Marine Hospital Service recorded it in his Annual Report as *Pulex pallidus*, from Memphis. This species is most commonly met with in seaports.

Collections of *Xenopsylla* cheopis have been made and submitted for determination throughout the year except in February. Collections, however, are reported for February in literature.

Hosts.--"Rats" 13; gray rat (*Rattus norvegicus*) 8; cotton rat (*Sigmodon h. hispidus*)5; roof rat (*R.r. alexandrinus*)4; black rat (*R.r. rattus*) 1: house mouse (*Mus. M. Musculus*) 1; man 1; cottontail rabbit 1; California ground squirrel (*Citellus beecheyi*).

Descriptors

Xenopsylla cheopis (Rothsch)
bubonic plague
domestic rats
cotton rat (*Sigmodon h. hispidus*)
gray rat (*Rattus norvegicus*)
roof rat (*R.r. alexandrinus*)
black rat (*R.R. rattus*)
house mouse (*Mus. m. musculus*)
man
cottontail rabbit
California ground squirrel (*Citellus beecheyi*)

Disease/Solid Waste
Abstracts

No. DSW- 313

Author

Atilio Macciavello

Title

Reservoirs and Vectors of Plague

Reference

Jrl. of Tropical Medicine & Hygiene

Doc. No.	Contract No.	Date issued
pgs. 1,4-8,45-8,65-9,88-94 etc.		Jan. 1954

Abstract

(Page 4) In reading this paper the fundamental consideration that very few of the fleas and animals reported as plague infected play a leading role in the maintenance and spread of plague, should be continuously kept in mind. Most of them are temporarily or accidentally involved in the disease without true signification to its epidemiology. They may be considered victims of plague to the same extent as human beings. Potential vector capacity of fleas or experimental susceptibility of animals to laboratory plague do not necessarily parallel natural field conditions.

Port and urban plague throughout the world is a primary disease of Rattus transmitted by very few flea species of which Xenopsylla cheopis and Nososyllus fasciatus are the only ones of real importance. Findings of plague-infected Rattus have not been mentioned, except for a few countries, as their occurrence is almost universal.

Sylvatic plague is a local enzootic phenomenon largely dependent on environmental ecology and rodent population dynamics. Epidemiologically speaking it can be said that there are as many sylvatic plagues as there are foci of the disease. The increasing knowledge of the mechanics of these foci has resulted in a parallel increasing number of descriptions of new reservoirs and vectors, but not one of these has the universal importance of domestic rats and their ectoparasites. Reported data are far from being accurate. Zoological nomenclature has continuously changed and sometimes it is difficult to correlate old names with new terminology. Field determinations made by epidemiologists without the assistance of expert zoologists are often based on the external appearance of the animals. General denominations, such as "field mouse" or "rats" lead to confusion. The same or similar remarks apply to fleas.

Descriptors

fleas and flea species
Xenopsylla cheopis
ecology
rats
reservoirs
plague
Nososyllus fasciata
rodents
carnivora
vectors
Rattus
slyvatic plague
epidemiology
birds

Abstract (continued)

Sylvatic plague is a disease of increasing importance, the control of which is still one of the main unsolved problems of tropical medicine.

(Page 142) Fleas: Common flea in wild animals of N.E. Brazil is Polygenis bohlsi jordani. Rattus fleas are common in wild animals living around human dwellings. Macciavello has found plague infected X. cheopis in Didelphis sp.; Galea sp.; Monodelphis domesticus, etc. In northeast Brazil the area was plague infected through a rat migration (R.rattus alexandrinus and R. rattus frugivorus) coming from the east. Plague infected ticks and fleas from C. lateralis have been reported in Colorado. Rattus (Rattus) rattus rattus Linnaeus, 1758; Rattus (Rattus) rattus alexandrinus Geoffroy; Rattus (Rattus) norvegicus norvegicus Berkenhout.

Common fleas throughout the United States in the 3 species of rat mentioned here are:

Ctenocephalides canis
Ctenocephalides felis
Echidnophaga gallinacea
Leptopsylla segnis
Nosopsyllus fasciatus
Pulex irritans
Xenopsylla cheopis.

Plague-positive rats, including the 3 common species of Rattus are very often mentioned under the general denomination of 'rats'. For this reason no distinction is made in the following list, but the 3 species play similar roles in domestic rodent plague:

San Francisco, 1902 til 1908 (probably 1900).
Seattle, Washington, 1907-1917.
Oakland, California, 1907-19-8, 1924-1925.
New Orleans, Louisiana, 1912, 1914-1917, 1920-1921, 1925.
Galveston, Texas, 1920-1921, 1922.
Pensacola, Florida, 1920-1921.
Los Angeles, 1925-1927, 1932.
Berkeley, California, 1941.
Richmond, California, 1941.
Oakland, California, 1941-1942.
San Francisco, California, 1942.
Marin County, California, 1942.
Tacoma, Washington, 1942-1943.
Oakland, California, 1943.
Pierce County, Tacoma water front, 1944 (in R. Rattus, R. alexandrinus and R. norvegicus).
Ventura County, California, 1946 (in the same species).

Carnivora are insusceptible to plague, but may transport plague-infected fleas of the infected rodents upon which they live. The same applies to other ectoparasites.

Jellisond, 1937, found the following rodent fleas in burrows and nests of scavenger birds:

Abstract (continued)

Foxella ignota
Monopsyllus exilis exilis
Monopsyllus wagneri
Neopsylla inopina
Pulex irritans
Thrassis pandorae

Wheeler, Douglas and Evans, reported infected fleas; 1941:
Echidnophaga gallinacea
Oropsylla idahoensis
Rectofrontia fraterna

Other birds, harbouring rodent fleas in their nests are: Asio wilsonianus, Bubo virginianus, Buteo sp., Pica pica hudsonia, the most common flea found being O. idahoensis (Jellison, 1937). Echidnophaga gallinacea, a vector of plague is found on several birds or in their nests.

Note: Predatory birds are not susceptible to plague.

Pages 158-171 cover North American reservoirs and vectors.

Disease/Solid Waste
Abstracts

No. DSW- 314

Author

H.B. Gotaas

Title

Composting: Sanitary disposal and reclamation of organic wastes

Reference

W.H.O. Monograph No. 31. 1956

Doc. No.	Contract No.	Date issued
pgs. 19-22,83-91,195-99		

Abstract

There is an important relationship between sanitation and agriculture in all parts of the world. In agricultural areas, the utilization of human and animal wastes is of great importance from both the public health and the agricultural points of view. The problem in highly industrialized countries is relatively new, but it is a very important one, which will require extensive future considerations to determine how these vast quantities of contaminated wastes from large cities can be satisfactorily disposed of and also utilized.

There are two important health aspects associated with the disposal and utilization of human and agricultural wastes. One is the high incidence of illness and death from faecal-borne disease which results from the insanitary disposal and utilization of wastes. Destruction of the causative organisms of the faecal-borne diseases or their removal from the environment is necessary for the satisfactory control of these diseases. The faecal-borne disease rate is invariably high in agricultural areas where inadequate sanitation exists and insanitary use of wastes is practised.

The diseases for which the causative organisms are found in faecal wastes can be classified broadly as: (a) those caused by bacteria, (b) those caused by protozoa, and (c) those caused by helminths. The faecal-borne bacterial diseases are bacillary dysentery, typhoid fever, paratyphoid fevers A and B, enteritis, and cholera. Also the Brucella organisms, which produce undulant fever in man, can be present in animal faeces and the disease can be faecal-borne. Similarly Coxiella burnettii, the causative agent of Q fever, may be present in manure and the disease can thus be faecal-borne. Similarly Coxiella burnetii, the causative agent of Q fever, may be present in manure and the disease can thus be faecal-borne. The faecal-borne protozoan diseases are amoebic dysentery, balantidial diarrhoea, and

Descriptors

sanitation
agriculture
animal wastes
faecal-borne disease
disposal
protozoa
helminths
bacteria
health hazards
composting
fly control
night-soil
sewage sludge
garbage
faeces
animal manure
abbatoir wastes
food-processing wastes

Abstract (continued)

flagellate diarrhoea. The faecal-borne helminth diseases are bilharziasis, fascioliasis, clonorchiasis, paragonimiasis, ankylostomiasis, ascariasis, trichuriasis, Cochin-China diarrhoea, and oxyuriasis.

Van Vuren[82] was unable to demonstrate any health hazards in properly managed composting operations in South Africa. His findings are confirmed by Blair,[10] Union of South Africa Health Department; Loots,[48] Union of South Africa Department of Agriculture; Hamblin of Johannesburg,[82] Acharya[1] in India; Scharff[66] in Malaya; and others in Great Britain, Germany, Australia, the Netherlands, Denmark, and New Zealand.[56,57,60,82]

In the case of anaerobic digestion of contaminated material in liquid suspension, such as sludge digestion, studies on the incidence and survival of pathogens and parasites have indicated that a considerable number of such organisms can remain viable for periods varying from less than a week to as long as six months, depending upon the organism, the nature of the digesting material, and the digestion conditions.[14, 58, 72, 92]

Good fly control is difficult, if not impossible, when food attractive to flies is composted anaerobically in stacks in warm weather. From reported experiments it seems evident that adequate compositn of faecal and other wastes, together with good sanitary practices, can control the faecal-borne diseases which are so widespread where faeces are used as a fertilizer without the practice of proper sanitary measures.

Special care must be exercised to safeguard the health of the compost-plant workers when night-soil or sewage sludge is added. Composting operations have been abandoned in some areas largely because of nuisances and health hazards resulting from carelessness in control of operations. In other instances there has been no difficulty concerning the health of the workers and little nuisance when composting raw faecal matter with refuse.

Garbage, faeces, animal manure, abattoir wastes, and tomato and several other food-processing wastes, are excellent media for the breeding and development of a large fly population. If adequate control measures are not practised, particularly when composting manure and faeces, the compost depot will be infested with extremely large numbers of flies, and a health hazard almost as serious as that caused by open, uncontrolled garbage dumps will be created.

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Disease/Solid Waste
Abstracts

No. DSW- 315

Author

J. D. Gregson

Title

Host Susceptibility to Paralysis by the Tick Dermacentor andersoni Stiles (Acarina: Ixodidae)

Reference

Canadian Entomology

Doc. No.	Contract No.	Date issued
V.90 pgs. 421-44		1958

Abstract

The only record of a native ungulate being paralyzed by the tick is that of wild buffalo, Bison b. bison (Linnaeus), in Montana (Kohls and Kramis, 1952). On the other hand, large domestic animals appear to be relatively susceptible to tick paralysis. A 1000-pound bull and a mature steer were found paralysed by single ticks. Usually, however, cattle do not become affected by fewer than a dozen ticks and often they may feed a hundred or more without ill effects.

Although observations have shown that horses are not readily infested by andersoni three were found paralysed by solitary ticks.

Sheep and dogs, although apparently more susceptible to tick paralysis than cattle, show a marked variation in their reaction to engorging ticks. On a number of occasions paralysis was produced by infesting these animals with only one or two ticks.

Man appears to be particularly susceptible to tick paralysis and, weight for weight, appears to be more sensitive to tick toxin than any other species. In about 250 case histories of the disease in British Columbia, of which 28 terminated fatally, only one female tick was invovlved in each.

It was discovered that andersoni females not only feed on groundhogs and groundsquirrels, but affect them with paralysis of the limbs about the fifth day after attachment. After this the animals usually became weak, lost their voices, and died within 12 to 24 hours. When the ticks were removed, recovery was slow (12-36 hours) and uncertain.

Summary: Large wild animals, buffalos in one instance excepted, appear to be resistant to tick paralysis. Large domestic animals are relatively susceptible, man appearing to be the most sensitive. Laboratory rabbits, guinea pigs, and mice all appear to be highly resistant to tick paralysis. Groundhogs

Descriptors

host susceptibility
paralysis
tick
Dermacentor andersoni Stiles
tick toxin
groundhogs
groundsquirrels
large wild animals
buffalos
large domestic animals
man

Abstract (continued)

and groundsquirrels, however, may be readily paralysed and killed by small numbers of female ticks. The condition was also produced in a groundhog by a subcutaneous injection of crushed salivarly glands of feeding ticks.

Disease/Solid Waste
Abstracts

No. DSW- 316

Author

J. C. Ayres, Editor

Title

Chemical and Biological Hazards in Food

Reference

Iowa State Univ. Press 1962

Doc. No.	Contract No.	Date issued
		1962

Abstract

Among the compounds thus far scrutinized and found to be carcinogenic for certain animals are butter yellow, dulcin, thiourea, thioacetamide, certain waxes, stilbestrol, safrole, aminotriazole, aramite and acetylaminofluorine. At this time I will call attention only to Publication No. 749 of the subcommittee on carcinogenesis of the Food Protection Committee (1960) and the Fifth Report of the Joint FAO/WHO Expert Committee on Food Additives (1960). These two reports contain many references to contributions by individuals and by groups.

At any rate there is now enough suggestive evidence to warrant a more careful scrutiny of such foods as smoked meats, especially smoked fish; oysters and shellfish; wheat and flour from selenium-rich soils; water and other foods containing radioactive materials, either occurring naturally or from fallout; foods containing safrole; plants containing estrogenic materials; plants containing goitrogenic substances; Senecio alkaloids, etc.

A paradoxical situation exists with respect to selenium. This element in small amounts has been shown to be a dietary essential for cattle and sheep, and in the Pacific Northwest, where the soil is deficient in selenium, so-called white muscle disease develops from the dietary lack of selenium. This deficiency may be prevented by the addition of selenium to fodder. However, in larger amounts selenium is a carcinogen and has produced hepatomas in rats. Chemicals necessary to adequate agricultural production are of the most diverse natures and purposes, as listed below: (See original article). Today there are more than 200 basic chemicals registered federally for pesticidal use in more than 7,000 formulations (Decker, 1960).

Both externally produced and internally produced alteration products may be toxicologically quite harmless, or they may be more toxic to mammals than were the parent compounds. These products, and the pesticide molecules unaltered by

Descriptors

smoked meats
selenium
safrole
goitrogenic substances
chemicals
pesticide residues
tolerances
food-borne disease outbreaks
reservoirs
salmonellae
feed
cestodes
tapeworms
beef tapeworm
pork tapeworm
broad fish tapeworm
Diphyllobothrium latum
Trichinella spiralis
trichinosis
vesicular exanthema
toxoplasmosis
fecal streptococci
Trematodes
flukes
Clonorchis sinensis

Abstract (continued)

micro-environments, in residence on and in plant and animal fissues, constitute "pesticide residues." Since late 1954 the U.S. Food and Drug Administration has established more than 2,000 tolerances for residues of these pesticide chemicals in or on a huge variety of raw agricultural commodities (Gunther, 1962).

Tolerance values are based upon the careful interpretation of extensive residue, pharacological, toxicological, and use data with a conservative built-in safety factor to permit declaration that these permitted levels are safe for human consumption. Pesticides are also acquired by plant parts through soil applications through sorption processes at root hairs and other subterranean organs and tissues; so acquired, these chemicals are also residues.

All of the unintentional food additives are poisonous in some degree. This is emphasized by the fact that cases of human poisoning are known in connection with most of them that have been used in significant tonnage. The list of such compounds applied to crops includes inorganic insecticides, botanical insecticides, chlorinated hydrocarbon insecticides, organic phosphorus insecticides, dinitro compounds, hormone-type growth regulators, fungicides and seed dressings, organic mercury compounds, and growth promoters. Cases of poisoning are also known in connection with pesticides that may contaminate food although they are not intentionally used on food crops. Such cases have involved the rodenticides, fumigants, household insecticides, and defoliating compounds.

Mortality caused by pesticides: The annual mortality in the United States from all causes is approximately 935 per 100,000, varying only slightly from year to year. Each year pesticides contribute approximately 10 percent of the deaths caused by solid and liquid materials. More than half of the deaths caused by pesticides are in children. During 1956, 68 percent of the deaths caused by pesticides were caused by compounds introduced before DDT.

Pathogenesis of Food-Borne Disease Outbreaks: It has been said repeatedly, although most explicity by Dauer (1961), that there is need for really representative information of the frequency and etiology of food-borne disease outbreaks.

Salmonellae: Savage (1932) pointed out that animals were the main reservoirs of salmonellae. A report (1947) described the isolation of salmonellae from dried whole egg imported from the United States of America during the war years, and also the many outbreaks of salmonellosis due to serotypes isolated from the dried egg but hitherto unknown in the United Kingdom. Frozen whole egg and dried egg albumen from China were bringing Salmonella schottmuelleri and many other salmonella serotypes into the country. Meanwhile the veterinary profession was proving poultry to be one of the most prolific sources of salmonellae. Imported frozen boneless meats, such as beef, veal and mutton were frequently contaminated with salmonellae. Home produced pork products from retail and manufacturing establishments were contaminated to the extent of approximately 2 per cent of samples. Earlier investigations showed that the same salmonella serotypes could be isolated from feed, pigs (rectal swabs), postmortem cecal swabs and sausage meat. Leistner et al (1961) found a relatively low incidence of salmonellae in animal feeds and pig intestines at the farm level. There was an increasing incidence in the pig intestine after the animals had arrived at the terminal market and after they had been held in pens; holding pen deposits were heavily infected. Leistner et al. (1961) found a relatively high incidence

Abstract (continued)

but low numbers of samonellae in rendered animal by-products used as feed constituents.

A study of the predominant salmonella serotypes indicated that *S. schottmuelleri* came not only from China in egg products, but also from Ceylon in coconut and the Argentine in frozen boneless horsemeat. *S. typhinmurium* was imported from a variety of countries in egg products, meat and coconut; certain serotypes were found more often in foods from one country than another. For example, *S. bareilly* was associated with Holland and *S. choleraesuis* with Yugoslavia. Similarly, particular phage types of *S. schottmuelleri* and *S. typhimurium* were associated with different countries and foods.

Cestodes in Food: The common tapeworms of man are adult forms of the genus *Taenia*, found as encysted larvae, called bladderworms or cysticerci, in the flesh of cattle and swine. The life cycle of these worms is maintained in areas where there is unsanitary disposal of human feces and access of the domestic animals to feed or water that has become contaminated with the excreta of a human being who harbors the tapeworm. *Taenia saginata*, the beef tapeworm, lives as an adult in the human intestine. When the eggs are ingested by bovines, the oncospheres hatch out under the influence of digestive juices and penetrate the intestinal wall. When meat is ingested by a human being, the scolex evaginates in the intestine and growth begins.

Taenia solium, the pork tapeworm, has a life cycle similar to that of *T. saginata*. *Taenia solium* is a much more dangerous parasite for man, because man can serve as its intermediate host, i.e. as the site for development of the cysticerci. *Taenia saginata* and *T. solium* are world-wide in distribution. The importance of the problem in different countries varies with the extent to which sanitary disposal of human feces is practiced, and with the meat-eating habits of the people. Schwartz (1956) stated that in the United States about 16,000 to 27,000 infected beef carcasses were found annually in abattoirs under Feceral inspection, where a total slaughter of 12-15 million head of cattle and 5.5-7.5 million calves was performed. However, to point up the importance of local conditions, Schwartz (1938) cited three examples of outbreaks of bovine cysticercosis with high rates of infection due to contamination of the feed and water with human excreta.

One other tapeworm, which man acquires from food, also merits mention here. This is the broad fish tapeworm, *Diphyllobothrium latum*. Because of the fact that fish-eating mammals other than man, such as the dog, bear, and other wild carnivores, may be infected with this tapeworm proper sanitation by itself cannot be expected to effect control of diphyllobothriasis.

As an example of the complicated trematode life cycle, we can select one of the important flukes of man, *Clonorchis sinensis*. This parasite, which is a most important pathogen in Asia, resides in the biliary ducts and produces extensive pathology in the liver leading to cirrhosis. Its eggs are deposited in the biliary passages, are passed into the intestine, and leave the body in the feces.

The causative agent of trichinosis is a most important parasite in food, responsible every year for considerable morbidity and mortality. It is especially common in Europe and North America, less frequently encountered in Africa and South America. It is associated most frequently with populations that eat raw or insufficiently cooked port. The cycle of most importance to man is maintained by swine-to-swine transfer through infected pork scraps in garbage. The widespread occurrence of infection with *T. spiralis* in human beings in the United States was reported by Wright, Kerr and Jacobs (1943).

Abstract (continued)

The areas of highest incidence are those in which the feeding of uncooked garbage to swine has been, at least until recently, extensively practiced by many municipalities. The feeding of uncooked garbage to swine has been reduced in most of the United States by laws enacted during 1953-1955. (It is noteworthy that this was accomplished not as the result of the repeated recommendations of public health workers (Wright, 1939a,b) to effect a diminution in cases of human trichinosis, but primarily to eradicate a nationwide outbreak of vesicular exanthema).

Various workers on toxoplasmosis have hypothesized that infected meat is a source of human toxoplasmosis. The assumulation of reports of this infection in swine, cattle, and sheep has lent support to these hypothese. Weinman and Chandler (1954, 1956) suggested that toxoplasmosis was maintained in swine in a manner similar to trichinosis, and reported finding evidence of the presence of the parasite more frequently in swine fed uncooked garbage than in swine fed cooked garbage. It is not believed that toxoplasmosis in swine and human beings is as intimately associated with trichinosis as Weinman and Chandler hypothesize.

In any assessment of the significance of fecal streptococci in food the question of their pathogenic potentialities must be considered. There have been reports of food poisoning in which fecal streptococci have been implicated.

Disease/Solid Waste
Abstracts

No. DSW- 317

Author
Thomas H. Wakley and Thomas
Wakley, Jun., Editors

Title

Typhoid Fever and the Pail System at
Nottingham

Reference

The Lancet, Vol. II. for 1902

Doc. No.	Contract No.	Date issued
	pgs. 1488-90	Nov. 29, 1902

Abstract

In regard to drainage Nottingham is altogether behind the age, with the result that typhoid fever is endemic and periodically assumes the epidemic form. Indeed, so serious is this that last year, according to the Registrat-General's returns, the death-rate at Nottingham from typhoid fever amounted to 0.35 per 1000 of the population, and was therefore higher than that of any other town. The medical officer of health of Nottingham, Dr. Philip Boobbyer, has repeatedly issued reports, maps, and diagrams to show the intimate relation between the prevalence of typhoid fever and the presence of pail-closets. It had been shown that out of 78 towns of Great Britain and Ireland, Nottingham possessed a larger relative number of pail-closets than any of these large towns, and excepting Manchester, it had a larger actual number. In 1897 there were still 40,225 pail closets in Nottingham and these were for the most part made of wood. There were only 7200 water-closets and 440 privies. Then, for the ten years 1887 to 1896 the figures were given--namely, the number of houses with pail-closets, the number of cases of typhoid fever occurring in such houses, and the ratio. Wherever situated, the introduction of water-closets insures relative immunity from typhoid fever. No infecting agent, such as water or milk, has been discovered. On the contrary, the districts where there are hardly any cases are supplied with the same water and with milt that often comes from the same dairy as that consumed in parts where there are numerous cases of the fever. But the wooden pail-closet is a distinctive characteristic of the districts where by far the greater number of cases of typhoid fever occur. It is not such an easy matter to dispose of the night-soil collected from the box-or pail-closets. Huge accumulations result. One of these depots of night-soil is near to a district of Nottingham which has specially suffered from typhoid fever. As much as 6000

Descriptors
typhoid fever
pail system
pail-closets
water-closets
water
milk
night-soil
dust

Abstract (continued)

tons of night-soil have been accumulated here and it has been noticed that during the prevalence of typhoid fever the wind for the greater part of the time blew over this depot of night-soil towards the district that suffered most from the fever. The heaps of refuse do occasionally receive, with other filth, dejections direct from typhoid fever patients. In such circumstances it is not surprising that cases of typhoid fever should occur when dust is carried by the wind from such accumulations towards inhabited houses.

Disease/Solid Waste
Abstracts

No. DSW- 318

Author

C. F. Craig

Title

Amebiasis and Amebic Dysentery

Reference

(Book) London, 1935

Doc. No.	Contract No.	Date issued

Abstract

The author discusses the transmission of amebiasis through use of night-soil on gardens (pp. 46-7), the importance of flies as transmitters of the disease agent (pp. 47-48) and an epidemic of the disease observed by the author and believed by him to be vectored by flies (pp. 56-58). This latter observation he supports by various epidemiologic arguments.

Descriptors

Endamoeba histolytica
feces
amebiasis
excreta
fertilization
flies
vegetable gardens
horses

Disease/Solid Waste
Abstracts

No. DSW- 319

Author

C.F.Craig and E.C. Faust

Title

Clinical Parasitology

Reference

Philadelphia 1940

Doc. No.	Contract No.	Date issued
		1940

Abstract

The tranmission of E. histolytica from person to person is usually accomplished through the ingestion of food or drink contaminated with feces containing the cysts of this parasite. It has been shown by several investigators (Thomson and Thomson, 1916; Wenyon and O'Connor, 1917; Roubaud, 1918, and Root, 1921) that the cysts may be found in a viable condition in the droppings of flies for as long as forty-eight hours after these insects have fed upon contaminated feces, and Frye and Meleney (1932) found cysts of this ameba in the intestine of flies caught in 3 of 12 houses where individuals infected with the parasite resided. The cysts have also been found to survive in the intestine of the cockroach (Macfie, 1922; Tejera, 1926, and Meleney and Frye, 1936) for as long as forty-eight hours after feeding on infected material, and Tejera (1926) produced amebic dysentery in two kittens by feeding the droppings of cockroaches containing the cysts.

The usual methods of transmission of E. histolytica are by the contamination of food or drink with the cysts by a polluted water supply; through the handling of food by infected individuals; by the droppings of flies and other insects; and through the use of human excrement in the fertilization of vegetable gardena.

The use of human excreta in the fertilization of vegetable gardens, so widely practiced in the Orient and to some extent in this country, despite laws to the contrary, is an important method of transmission. As the cysts may remain alive for several days in moist fecal material, the danger from this method of transmission may be readily appreciated. The contamination of food and drink by the droppings of flies that have fed upon material containing the cysts of E. histolytica is an important method of transmission where flies are numberous and foodstuffs are unprotected from these insects. This method is most important in military camps, work or recreation camps, and wherever large number of individuals are gathered together

Descriptors

Entamoeba histolytica
flies
Leishmania donovani
Phlebotomus
kala-azar
dog
cat
horse
sheep
rats
L. tropica
Oriental sore
trypanosomes
T. gambiense
tsetse flies
reservoir hosts
opossum
wood rat
Balantidium coli
pigs
fertilizer
Strongyloides stercoralis
Ancylostoma Duodenale
Wuchereria bancrofti
Schistosomiasis
destodes
tapeworms
Diphyllobothrium latum
T. saginata
T. solium
Hymenolepis nana
Rocky Mountain Spotted Fever
Dermacentor andersoni
Dermacentor occidentalis
dog tick
Dermacentor variabilis
Tularemia
Pasteurella tularensis
relapsing fever

Continued on page 8

Abstract (continued)

and flies are prevalent. Epidemics of amebic dysentery may occur if conditions are favorable; such epidemics are usually caused by a polluted water supply.

Leishmania donovani: Epidemiology--Despite many years of research by eminent observers the method of transmission of *L. donovani* from man to man is still a matter of controversy, although there are sufficient data available to prove that the transmission may occur from one experimental animal to another through the bite of infected flies of the genus *Phlebotomus*. Today the only insects considered to be transmitting agents are flies of the genus *Phlebotomus*.

While it is possible to transmit *L. donovani* to these animals by the bites of infected sand-flies, the small number of successful experiments indicates that this may not be the usual method of transmission, and attempts to transmit the parasite to 6 human volunteers by the bites of infected *P. argentipes* were negative.

Of 73 laboratory bred sand-flies of this species, allowed to feed on kala-azar patients, 5 were found infected with flagellates, a percentage of 6.85. These comparatively high percentages of infection indicate that *P. chinensis* probably plays an important part in the transmission of kala-azar in China. A possible method of transmission is through the ingestion of food or drink contaminated with *L. donovani*. This parasite may be found in the feces and urine of kala-azar patients, and susceptible animals, as the hamster, may be readily infected by feeding them material containing the flagellate. While there is no evidence proving that man can become infected through contaminated food, the Indian Kala-Azar Commission regards this possible method of transmission as important and demanding further study. Contact infection may be possible.

Beside the dog, the car (Sergent, Lombard and uilichini, 1912), the horse (Richardson, 1925-1926), and the sheep (De Paolis, 1935) have been reported as infected with leishmanias resemling *L. donovani* in morphology. The following animals may be infected experimentally: white mice, rats, guinea-pigs, rabbits, gerboas, gerbils, hamsters, jackals, dogs and monkeys.

Poor hygiene, moisture and a moderate degree of heat appear to favor infection, and the disease is more prevalent in rural districts than in cities. The infection is frequently localized and family infection is common.

Oriental sore is practically universal in natives in endemic areas. Contact infection is possible; the infection is inoculable and autoinoculable. It is believed that the most common method of transmission in Nature is through the bites of a sand-fly, *Phlebotomus papatasii*. This fly has been found naturally infected with L. tropica but thus far all attempts to produce infection in man by bites of infected flies have resulted negatively.

It would appear (1) that *P. papatasii* does become infected with *L. tropica* if it feeds upon Oriental sores, and (2) that it is possible to produce these sores in man by inoculating material containing the leishmanias which have developed in the fly, although the crucial experiment of transmitting infection by the bite of the fly has not been successful. Monkeys, dogs, rats, mice, and guinea-pigs can be experimentally infected with *L. tropica*, easily demonstrating the causal relationship of this parasite to Oriental sore.

Epidemiology--Transmission of *T. gambiense* from man to man usually occurs through the bites of flies belonging to the genus Glossina (the tsetse flies). Both male and female flies bite man and may transmit the trypanosome. The fly

Abstract (continued)

may transmit the infection mechanically or by its bite after a period of development of the trypanosomes within the insect. The usual method of transmission is through the bite of the fly after the trypanosomes have gone through the metacyclic phase of the cycle in the fly.

As regards reservoir hosts of *T. gambiense*, it has already been stated that there is not sufficient evidence to prove that any of the game animals of Africa act as reservoirs of infection for man, but it is true that domestic animals, as sheep, cattle and goats, because they many carry this infection for long periods of time without apparent symptomatology, must be regarded as potential reservoir hosts of the parasite.

Epidemiology-- The usual method of transmission of *T. cruzi* from man to man in South America is by the triatomid bug, *Panstrongylus megistus*. Besides this species numerous other arthropods have been proven to be natural transmitters of, or experimentally capable of, infection with *T. cruzi*.

Trypanosoma cruzi: The method of transmission of *T. cruzi* is the contaminative one, the feces of the arthropod containing the metallic trypanosomes being rubbed into the wound. This occurs easily, as the transmitting arthropod defecates while biting and the contaminated fecal material is rubbed into the puncture wound by scratching or otherwise. In California, Kofoid and Donat (1933) found that *T. protracta* is apparently the transmitting bug from animal to animal. The observations of the latter are especially interesting to physicians in the United States, for they have found natural infections with *T. cruzi* in the opossum and wood rat, and, although no human infections have yet been discovered, it is more than probable that, with animal reservoirs and a transmitting insect present, the infection of man has occurred but has not been recognized.

Balantidium coli: Epidemiology--Man is infected by swallowing the cysts of *B. coli* in food contaminated by fecal material, or by direct transference of infected pig's feces to the mouth through soiled hands in handling pigs or in slaughtering operations. Considerably over 25 per cent of the recorded cases of infection give a history of direct contact with pigs, while the use of the excrement of pigs as fertilizer may be the source of some infections, as the cysts are quite resistant to physical and chemical agencies.

Epidemiology--While man is the important host of *Strongyloides stercoralis*, dogs have been found naturally infected with a strain morphologically and physiologically indistinguishable from that in man. The infective-stage larvae are developed in the soil, from which man becomes infected typically through skin contact. Much remains to be learned of the epidemiology of this infection.

Epidemiology--Ancylostoma Duodenale. The infective filariform larvae, which develop in moist shaded soil in warm climates, enter the human body typically by the cutaneous route, most often where the skin of the bare foot has come in contact with soil previously polluted with excrement of an infected individual. Man alone constitutes the source of infection for other human beings.

Ascaris lumbricoides--Man is apparently infected only with eggs from human sources. Epidemiology--Human infection is acquired by ingesting fully embryonated eggs which have been accidentally picked up from the soil polluted by the same or other human beings, or from food or drink contaminated by viable embryonated eggs. Young children are more commonly infected than adults and more commonly pollute the soil.

Abstract (continued)

Filariasis: Man is the only known definitive host of Wuchereria bancrofti. Epidemiology--Man is inoculated with mature larvae escaping into or onto human skin from the proboscis of infected mosquitoes, which serve as intermediate hosts of the organisms in endemic foci. These moquitoes have previously become infected from ingesting the microfilariae of the organism swarming in the peripheral blood of actively infected human subjects, usually during the night-time.

Schistosomiasis: Epidemiology--Infection results from contact with water into which the cercariae of the schistosome have been discharged from the infected snails. In Modhammedan countries that are in endemic foci, religious practices tend to increase both the pollution of the water and the exposrue to infection. All of the snails involved are sewage-feeders.

Ingestion of the infected flesh of the intermediate host, raw or inadequately cooked, constitutes the source of human infection with Diphyllobothrium latum, T. saginata and T. solium. Sanitary disposal of human feces containing the viable eggs of these tapeworms will protect communities. Improper personal hygiene with respect to contact with feces of man (Taenia solium and Hymenolepis nana), feces of dogs (Echinococcus granulosus) or the insect vermin of domestic animals (Dipylidium caninum, H. diminuta) accounts for all of the remaining tapeworms except a few infections rarely reported for man. In all known tapeworm infections, except ocular sparganosis, in which the infection is topical, the portal of entry is the mouth. Sanitary disposal of human excreta and those of domestic animals constitutes the more fundamental and more urgent public health problem.

Epidemiology--Many animals other than man have been found infected with D. latum. These include the domestic dog, the domestic cat, the mongoose, the walrus, seals and sea-lions, foxes, the mink, bears, and the domestic pig. Nevertheless, man is primarily responsible for the propagation of the infection in endemic areas.

Hymenolepis nana: Epidemiology--This is the only human tapeworm typically utilizing no intermediate host; infection is direct from patient to patient. It is more common in children than in adults, more frequent in family and institutional groups than in the populaton as a whole.

Taenia solium: Epidemiology--Man is the only known defnitive host. The pig is the exclusive source of human infection, although man and other primates, less frequently sheep and dogs, may harbor the cysticerus stage.

Taenia saginata: Epidemiology--Human infection is acquired from consumption of raw beef containing the cysticercus larva. Cattle become infected from grazing on ground polluted by human feces containing the eggs of the parasite.

Arthropods (i.e., insects and their allies belonging to the Phylum Arthropoda) are probably more important than all other groups in the Animal Kingdom, except man himself, as transmitters to man of disease-causing organisms. The great majority of these infections is usually, if not always, acquired by human association with the appropriate arthropod.

In malaria man is the only known source from which the anopheline moquito obtains the infection. Similarly, the filaria worms which infect man are, as far as is known, always derived from human sources. Arthropods themselves play a significant part as disease-producing organisms. Certain species invade the tissues of man and cause serious lesions.

Abstract (continued)

Ticks as Transmitters of Disease--1. Rocky Mountain Spotted Fever -- The Rocky Mountain wood tick, *Dermacentor adersoni* is the common transmitter of of Rocky Mountain spotted fever (a disease caused by a minute but visible organism, *Dermacentroxenus rickettsi*). This virus is transmitted in Nature from rodent to rodent by the bite of the numphal stage of this tick, as well as by that of *Haemaphysalis leporis-palustris*, the North American rabbit tick. The virus survives the moulting period and is present in the adult tick, which usually attacks man from March to July. Females transmit this infection to their young, and males through their spermatozoa which fertilize the eggs. On the Pacific Coast of the United States *Dermacentor occidentalis* is the tick which probably transmits the infection to man. The common dog tick of the southeastern United States, *Dermacentor variabilis*, has been found naturally infected in this area. This tick is also found in Oregon and California.

Tularemia, produced by *Pasteurella tularensis*, is known to be transmitted by ticks. *Dermacentor andersoni* and probably *D. occidentalis* and *D. variabilis* may transmit it to man in the United States.

Relapsing Fever--Caertain types of relapsing fever (*Borrelia duttoni* et al.) are transmitted by ticks of the family Argasidae.

The spirochete is known to be congenitally transmitted from adult female ticks to their offspring, even of the third generation.

Prevention of Tick-borne Disease of Man--While temporary immunization to the clinical effects of Rocky Mountain spotted fever may be provided by vaccination, this same protection is at present not available against the other tick-transmitted diseases. Prophylaxis is, therefore, provided solely by avoiding the localities where ticks abound, or preventing them from biting or discharging their excretions on the skin. There is no satisfactory tick repellant which can be placed on the skin or clothing.

Harvest Mites, Chiggers, 'Red Bugs"" Transmission of Disease --In Japan, Formosa, the Pescadores, the Federated Malay States, Sumatra, Samoa, and possibly in China, French Indo-China, the Philippines and South Australia, the larvae of species of Trombidium are transmitters to man of an important infection of rickettsial origin (*Rickettsia orientalis* Nagayo, 1931), which in Japan is referred to as "river fever" or "tsutsugamushi disease" (tsutsugamushi is the Japanese name for a mite), in Formosa as "pseudo-typhus," and in the Federated Malay States as "scrub typhus." The virus in Japan is commonly present in field mice, rats and voles, particularly the vole. In other endemic foci in the Orient varieties of the black rat are infested with species of *Trombidium* which transmit this virus to man.

Prevention of Mosquito-borne Disease--A prerequisite to the control of mosquito-transmitted diseases in a locality includes an intelligent grasp of: (1) The disease involved, especially insofar as the mosquito is concerned (i.e., the etiology, epidemiology, stage of the pathogen infective for the mosquito, the incubation or developmental period in the mosquito and the stage and mechanism of transmission of the etiological agent); (2) the species of mosquitoes involved, their breeding places and life cycles; (3) criteria for recognizing the particular moquitoes in their several stages of development; and (4) the methods available for mosquito control or eradication.

A survey of the tabulated data shows that some mosquitoes, like *Aëdes aegypti*, *A. albopictus*, *Culex fatigans*, *C. pipiens* and *Anopheles stephensi*, are domestic in their habits, breeding in household receptables, as cisterns, earthenware jars, gutters, ets. Mosquitoes may fly distances of two miles or more and may be

Abstract (continued)

carried hundreds of miles by wind and thousands of miles in trains or airplanes.

In measures directed against purely domestic anophelines (i.e., A. stephensi), which breed in crockery, cans, etc., around the home, careful inspection must be made by sanitary police to see that these receptacles are kept empty, covered with kerosene or adequately screened, just as in control of Aedes aegypti breeding.

Filariasis and Mosquito Control--This is essentially an urban problem. The mosquitoes are usually either domestic (Culex fatigans, C. pipiens, Aedes aegypti, A. variegatus, Anapheles stephensi) or are found in bodies of water not far from human habitations.

Non-Blood-Sucking Flies as Mechanical Vectors of Disease: Conditions under which Flies serve as vectors--Flies which mechanically transmit pathogens to man are domesticated species, which as adults, feed indiscriminately on human feces and human food. Most microorganisms are carried either (1) on the soiled external hairs, bristles, foot pads and external mouth parts, or (2) in the digestive canal of the fly later to be deposited in vomitkdrops or fecal drops. The flies which conform to these conditions include: the common house fly (Musca domestica) and related species of this genus; the lesser house flies (Fannia canicularis, F. scalaris); the non-biting stable fly (Muscina stabulans); the green-bottles (Lucilia caesar, L. sericata); the blow flies (Cochliomyia macellaria, Chrysomyia bezziana); the flesh fly (Sarcophaga haemorrhoidalis); the banana or vinegar flies (Drosophila spp.); the hover fly (Eristalis tenax) and the cluster fly (Pollenia rudis). Furthermore, flies like Hippelates pusio, which feed on human serous and purulent exudates, are admirably equipped to serve as vectors of microorganisms causing cutaneous infections and those of the mucous membranes.

Diseases Mechanically Transmitted--The diseases which these flies can and do at times mechanically transmit for the most part belong to the enteric group. Experimental and epidemiological evidence has incriminated Musca domestica, the most serious offender, in the following important enteric infections: Eberthella typhi, Salmonella paratyphi, S. enteritidis, Shigella dysenteriae, Vibrio comma and Endamoeba histolytica. The control of house flies and other domestic flies not only has been responsible for the decline in numerous typhoid epeidemics, but in other instances has undoubtedly prevented their outbreak. Bacillary dysentery has been similarly shown to be spread by flies (Paraf, 1920; Kvasnikova, 1931).

Om mpm-enteric infections domestic flies have been definitely associated with the spread of the following representative pathogens: Mycobacterium tuberculosis (Graham-Smith, 1897); Pasteurella pestis (Yersin, 1894; Nuttall, 1897; Russo, 1930); P. tularense (Wayson, 1914); Bacillus anthracis (Graham-Smith, 1910-1912); Brucella abortus (Nishimoto, 1931); trypanosomes, leishmanias and Treponema pertenue, by interrupted feedings of Musca spectanda (Thomson and Lamborn, 1934). Furthermore, Herms (1928) in California and Bengtson (1933) in the southeastern United States have proven the vector relationship of Hippelates to acute catarrhal conjunctivitis ("pink eye"), while Ayyar (1917) has suspected Siphunculina funicola in catarrhal ophthalmia in India and the Far East. Kumm and Turner (1936) state that H. pallipes is probably a good transmitter of Treponema pertenue, the cause of yaws, from man to man, since the spirochete has been successfully passed from man to rabbit through the intermediary of this fly. There is also some epidemiological evidence that eye gnats and other flies are mechanical contact agents causing the spread of trachoma.

Abstract (continued)

Flies and Human Myiasis: Myiasis is the invasion of the living animal tissues by fly larvae.

Filth flies breed in horse manure, human feces, garbage and decaying organic matter around the house, in city dump heaps, on the seashore and on the farm, and in other exposed decaying or fermenting materials, on which both the adult flies and their larvae feed. In cities, where horses are now relatively uncommon, where garbage is collected daily and is completely incinerated, where markets are well supervised and where modern sewerage systems are in use, the problem has been essentially solved. On farms or in small villages, where there are many domestic animals, where manure is stored in piles on the ground, and where unprotected outdoor privies are still in use, filth flies constitute both a nuisance and a threatening danger, particularly during the summer months.

Flease and Disease: Plague is an infectious, and, at times, a contagious disease, primarily confined to the lu mph nodes (buonic type), but secondarily involving the blood stream (septicemic type) and the lungs (pneumonic type). In Nature, plague is endemic among rodents and is transmitted from infected rodents to healthy ones by their fleas. Probably the most usual residual infection is in the brown rat (M. norvegicus), but when conditions become favorable for infection of the black rat (M. rattus), which is more closely associated with human habitations, the disease usually breaks out in epidemic form in the human population. In endemic foci, where epizoötics of plague occur in rodents other than M. norvegicus and M. rattus, the fleas commonly associated with these rodents are the primary transmitters of the disease from rodent to rodent and at times from rodent to man.

Typhus--Endemic, or murine typhus, formerly referred to in the United States as "Brill's disease," is a mild form of Rickettsia prowazeki infection, with low mortality, which is believed to be due to passage of the virus through reservoir murine hosts. The disease is one of occupation rather than of domicile, is sporadic rather than epidemic in man, and is most common in persons handling foods infested with rats. While this benign form of typhus fever may be transmitted from rat to rat by the rat mite, Liponyssus bacoti. or from man to man by the human louse, Pediculus humanus (not definitely proven), the common insect vectors are Ceratophyllus fasciatus and Xenopsylla cheopis, although X. astia and Pulex irritans have also been experimentally infected.

Fleas as the Transmitter of Other Pathogens--Ctenocephalides canis, C. felis and P. irritans are the intermediate hosts and transmitters of the dog tapeworm, Dipylidium caninum (vide supra, page 450); C. canis and P. irritans of Hymenolepis diminuta and possibly of H. nana; and C. fasciatus, X. cheopis, Leptospylla segnis and other murine fleas have been proved to be intermediate hosts of Hymenolepis diminuta (vide supra, pp. 463, 465). A squirrel flea, Ceratophyllus montanus, as well as rabbit fleas, have been experimentally incriminated as transmitters of tularemia, but there is no evidence that man contracts the disease through these fleas.

Flea dermatitis-- The "bites" of fleas are practically innocuous to many persons, but cause considerable inconvenience to others, on whose skin a roseate, raised lesion, frequently edematous, and at times, indurated or even pustular, develops. Local application of carbolated vaseline is usually palliative. In

Abstract (continued)

the case of chigoe, *Tunga penetrans*, which invades the epidermis of man, the pig, the dog and other mammals, both males and females such blood, but only the gravid female burrows into the skin and engorges herself until she frequently becomes as large as a pea. The sites most usually attacked are the soles of the feet and the interdigital spaces, but no topographic area of the body is immune against attack.

Control of Fleas and Flea-borne disease: Flea control, in so far as human diseases are concerned, may be divided into two categories: (1) That which involves fleas of dogs, cats and the human fleas around the home, and (2) that which has to do with fleas of rats and other rodents, in attempts to control plague and murine typhus. The former problem requires the periodic defestation of dogs and cats. Plague and murine typhus--control of these diseases requires anti-rodent-flea measures; starvation of rats, wherever possible, by keeping garbage as well as clean food in covered or rat-proof receptacles.

Descriptors (continued from page 1)

Borrelia duttoni
immunization
harvest mites
chiggers
Trombidium
tsutsugamushi disease
scrub typhus
black rat
Aëdes aegypti
A. albopictus
Culex fatigans
C. pipiens
Anopheles stephensi
Musca domestica
Fannia canicularis
F. scalaris
Muscina stabulans
Lucilia caesar
L. sericata
Cochliomyia macellaria
Chrysomyia bezziana
Sarcophaga haemorrhoidalis
Drosophila spp.
Eristalis tenax
Pollenia rudis
Hippelates pusio
plague
brown rat
M. norvegicus
black rat
M. rattus
murine typhus

Disease/Solid Waste Abstracts

No. DSW- 320

Author

C. Fox

Title

Insects and Disease of Man

Reference

Philadelphia: P. Blakiston's Son and co.

Doc. No.	Contract No.	Date issued
		1925

Abstract

Plague: Three clinical forms of plague have been described, bubonic, septicaemic, and pneumonic plague. The first is the common form and is primarily a disease of rodents, from which it is transmitted to man by a biting insect, a flea. Pneumonic plague is that condition in which there is primarily a pneumonia caused by the plague bacillus. It is spread direct from man to man. In recent years, the British Indian Plague Commission, as well as other investigators, have proved conclusively that the flea is responsible.

Other rodents which are known to be concerned with the spread of plague are, the ground squirrel of California (Citellus beecheyi) and the Siberian marmot (Artomys bobac). The flea concerned is the one having the plague animal as its normal host.

In rural districts rats often occupy nests of other animals such as the rabbit, squirrel, or field rat. There is then a transfer of fleas between different rodents and thus the possibility of transferring infection to the rodents common to rural districts. This has been the case with regard to the ground squirrel of California and accounted for the finding of infected wild rabbits in England and field rodents in South Africa.

In the prevention and control of bubonic plague the great object to be attained is that of placing the environment in such condition that man and rat or its fleas will not come into contact. It is quite possible to reduce the rat population by trapping and poisoning, and to finally build them out of existence, by proper rat proofing procedure, at the same time abolishing all conditions that furnish a harboring or breeeding.... Proper care of household garbage is important. It should be kept in a galvanized iron can with tight fitting cover, and should be collected at least once a week, and disposed of in an approved manner.

Descriptors

plague
rodents
flea
ground squirrel
Siberian marmot
Xenopsylla cheopis
Ceratophyllus fasciatus
Ceratophyllus acutus
Hoplopsyllus anomalus
Ceratophyllus silvantieri
control
garbage

Disease/Solid Waste Abstracts

No. DSW- 321

Author

Manson - Bahr, P.

Title

The Dysenteric Disorders

Reference

London

Doc. No.	**Contract No.**	**Date issued**
		1939

Abstract

The spread of bacillary dysentery--The spread of bacillary dysentery from man to man takes place either by (1) direct or (2) indirect contagion.

2. Indirect contagion. Dysentery bacilli can be conveyed by the agency of house-flies and possibly by water. The evidence against the house-fly is fairly complete. Working along the same lines as those pursued by Graham Smith in 1913 and 1914, the author (1912) originally obtained evidence that in Fiji house-flies act as the main agents in conveying the infection by transferring it to foodstuffs. In the Pacific Islands house-flies constitute a great plague in the dysentery season, and they are attracted by faecal material, especially dysenteric stools, on which they feed readily. Apparently the bacillus can be conveyed to food by the fly in two ways: firstly, by its vomiting ingested dysenteric material directly on to the food--its normal prelude to feeding--and secondly, by its defaecating on to any article of diet in the kitchen or on the table.

It has generally been noted that epidemics of house-flies coincide very closely with epidemics of bacillary dysentery, and that the incidence of the disease diminishes during the season when these insects are comparatively rare. This takes place, in the Near East and in Africa, during the hot season when the majority of the fly larvae are destroyed by the rays of the sun.

Amoebiasis: Epidemiology-- Transmission by flies. J.G. Thomson and D. Thomson (1916) were the first to note that house-flies (M. domestica) could transport cysts in their intestinal canals and pass them unchanged in the dejecta. From this work it can be concluded that, under tropical and subtropical conditions, house-flies normally act as disseminators of amoebic dysentery to a somewhat limited extent. It is believed that on the whole they are to be regarded as a more important factor in the spread of bacillary than of amoebic infection.

Descriptors

bacillary dysenteries
house-flies
amoebiasis
cholera

Abstract (continued)

Transmission by human excreta--There remains another possibility--that the parasitic cysts are ingested with green vegetables and raw fruit in those localities, so frequent in the Near East and the tropics, where human "night-soil" is used for agricultural purposes.

Cholera is mainly a water-borne disease, and the bacillus enters by the stomach; there have been numerous historic instances which bear this out.

Disease/Solid Waste
Abstracts

No. DSW- 322

Author

J.A. Logan, P. Oppermann, N.E.Tucker

Title

Environmental Engineering &
Metropolitan Planning

Reference

First Conf. Proc.

Doc. No.	Contract No.	Date issued
		1962

Abstract

Today's population explosion and the trend toward urbanization, with its high population densities, demand improved planning and management in the handling of solid wastes in order to achieve the optimum in environmental sanitation. It is estimated that our present population of 180 million persons produces over 110 million tons or about 600 million cubic yards of refuse each year. Unclean streets and lots breed insects and rodents, spread disease and odors, help to pollute the air and, of course produce unsightliness.

The term "refuse" is generally applied to the following solid wastes, either singly or in any combination: (1) food wastes such as garbage and swill; (2) rubbish such as rags, paper, cans, glass and china, wood, and similar miscellany; (3) garden trash such as grass and flower cuttings, shrub and tree trimmings; (4) ashes and other residuals from burning; (5) demolition and construction wastes such as plaster, masonry, lumber, etc., and (6) industrial and commercial wastes.

Excluding industrial wastes, the total refuse produced ranges from 1100 to 1700 pounds per capita per year with a median weight of 1450, or about 4 pounds per capita per calendar day. Industrial wastes, usually of a specific and sometimes of a hazardous character, are usually disposed of by industry itself; here the municipality's responsibility is limited to supervisory controls and regulations. Domestic and commercial wastes, on the other hand, are usually collected and disposed of by the municipality.

It is suggested that the ultimate in environmental sanitation might be best achieved through the use of household grinders and domestic incinerators. At present, domestic incinerators are still unsatisfactory as to thoroughness of burning and freedom from odor, exhaust nuisances, and air pollution. The several alternate methods now acceptable flrom a sanitary and economic point of view are piggeries,

Descriptors

solid wastes
sanitation
refuse
quantities
composition
rubbish
garden trash
ashes
demolition and construction wastes
industrial and commercial wastes
piggeries
grinding
domestic incinerators
composting
sanitary landfilling
municipal incineration
street refuse

Abstract (continued)

grinding, domestic incinerators, composting, sanitary landfilling, and municipal incineration. Their respective descriptions and merits may be summed up as follows: ....

Street refuse is comprised of dirt washed in from adjoining unpaved areas, leaves and other tree droppings, abraded particles from vehicular and pedestrian traffic, bird and animal droppings, settled-out air pollutants and litter of all types. The amounts will vary with season, character of neighborhood, type of traffic, and degree of public cooperation, and ranges from 25 to 50 cubic yards per gutter-mile per year.

Disease/Solid Waste
Abstracts

No. DSW- 323

Author

Wiesner Report

Title

Use of Pesticides

Reference

Govt. Printing Office:1963 (LC63-61540)

Doc. No.	Contract No.	Date issued
PR35.8:SCI 2/P43		5-15-63

Abstract

The term pesticide broadly includes compounds intended for a variety of purposes. They are used to control insects, mites, ticks, fungi, nematodes, rodents, pest birds, predatory animals, rough fish, plant diseases, and weeds; and also to act as regulators of plant growth, as defoliants, and as desiccants. As of June 1962, almost 500 compounds incorporated in more than 54,000 formulations were registered for use in the United States.

1. The chlorinated hydrocarbons containing carbon, hydrogen, and chlorine are the pesticides used in greatest tonnage. The most familiar are DDT, dieldrin, aldrin, endrin, toxaphene, lindane, methoxychlor, chlordane, and heptachlor. Among those used extensively as herbicides are 2,4-D and 2,4,5-T for control of broad-leaved weeds in lawns, pastures, cereal crops, and brush growth along highways and fences.

2. The organic phosphorus compounds, composed of phosphorus, oxygen, carbon, and hydrogen, are used principally as insecticides and miticides. Parathion, malathion, phosdrin, and tetraethyl pyrophosphate (TEPP) are examples.

3. Other organic compounds include the carbamates, dinitrophenols, organic sulfur compounds, organic mercurials, and such natural products as rotenone, pyrethrum, nicotine, strychnine, and the anticoagulant rodent poisons.

4. Inorganic substances with a long history of use include copper sulfate, arsenate of lead, calcium arsenate, compounds of chlorine and fluorine, zinc phosphide, thallium sulfate, and sodium fluoroacetate.

Exposure of man-- The extent of hazard associated with use of apesticide is determined by the degree of exposure and the compound's toxicity. Exposure depends on persistence, the amount applied, the method of application, and availability

Descriptors

pesticide
chlorinated hydrocarbons
organic phosphorus compounds
other organic compounds
inorganic substances
exposure
toxicity
insecticides
absorption
inhalation
soil
effects
poinsoning

Abstract (continued)

of the chemical in a biologically active form. Pesticides can enter the body by (a) ingestion, (b) absorption through the intact skin, and (c) inhalation. Most insecticides are readily absorbed through the intact skin. The rate of absorption through the skin depends on the chemical nature of the pesticide and on its formulation. In general, compounds in solution in oils or in organic solvents are absorbed more readily than those in aqueous preparations or in dry powder. Skin absorption can occur from ptesticide aerosols, from dusts, from clothing or blankets impregnated with chlorinated hydrocarbons, and from contaminated soil or lawn grass.

Man's exposure to pesticides can also occur through inhalation. Airborne insectides are sources of exposure when released during fogging operations directed against nuisance insects in public areas, buildings, and homes. Pesticides may be inhaled in dusts from treated soil. Unfortunately, possible long-term effects of other compounds cannot be predicted on the basis of experience with DDT, or even predicted for DDT itself, on the basis of the limited clinical studies available.

Accidental acute poisoning in man has been caused by about 50 pesticides, including at least 1 compound from each major class. Each year, approximately 150 deaths are attributed to misuse of pesticides in the United States. About half of these occur in children who were accidentally exposed at home. The number of nonfatal poisonings can only be estimated. A Special Committee on Public Policy Regarding Agricultural Chemicals, appointed by Gov. Edmund G. Brown on June 15, 1960, reported that in California, which uses 20 percent of the nationally consumed pesticides, 3,000 children per year ingest various amounts of these compounds. In that State during 1959 there were also 1,100 cases of occupational disease due to agriculture chemicals, mostly among agricultural workers. These figures include acute illnesses, whether the reaction was very mild, or severe enough to require hospitalization. One difficulty in estimating the incidence of poisoning is that the symptoms caused by pesticide toxicity are little different from those of many common illnesses.

Little is known about the consequences to man when he accumulates more than one pesticide in his body. Synergism, or potentiation, is the joint action of two agents which results in an effect which is greater than the sum of their individual effects. Some combinations of two organic phosphates have produced effects 10 times those observed when either compound was fed separately. Preliminary FDA data show only additive effects from mixtures of chlorinated hydrocarbons included in diets of experimental animals.

Physicians are generally unaware of the wide distribution of pesticides, their toxicity, and their possible effects on human health. Diagnosis of pesticide toxicity is apparent when a patient with acute asthma has to be resuscitated in the middle of the night following exposure to commercial fogging. However, diagnosis is difficult in patients with nonspecific symptoms that may result from unsuspected contamination with pesticides. The Panel was unable to find any federally sponsored research in this area of potential medical importance.

Disease/Solid Waste
Abstracts

No. DSW- 324

Author

E. Van Oye, Ed.,

Title

The World Problem of Salmonellosis

Reference

Monographiae Biologicae (Den Haag)

Doc. No. **Contract No.** **Date issued**
1964

Abstract (Translation by T. G. Hanks)

Page 171 - Chapter by Hans Fey: Salmonellosis of domestic animals and their epidemiological importance.

Numerous authors have emphasized repeatedly that, in the last ten years, human and animal salmonellosis has undergone a steady increase. Edwards[26] refers to an often dramatic increase of serotypes, previously seldom if ever encountered in men or animals and sees a direct correlation between human and animal salmonella species in a given region. Schofield (Buxton[14]) by 1945 had emphasized that there was no longer a boundary to be recognized between human and animal salmonellosis and further, that the so-called animal species had reached a permanently elevated level of importance in regard to human infection.

The described increase of animal infection, along with ever new species of Salmonella which frequently are to be observed throughout the world, has, however, not lead to broad epidemics in man, but rather in the majority of cases to sporadic outbreaks, (Edwards 25) ... at any rate, under these new circumstances it appears that animals continue to play a disastrously commanding role as the reservoir for human salmonella infection and that endemic infection of animals has become heavier since the symptomless excreters increase steadily and, as a result, animal fodder harbors increased numbers of salmonella.

Page 172 - Newell[86]: Newell has demonstrated convincingly that the source of Salmonella (always apart from man-adapted Typhoid-Paratyphoid) ultimately lies in animals and that the long-range prevention of human Salmonellosis is to be sought in the interruption of animal-to-animal contact and not of man-to-man contact. Thus animals stand at the mid-point of salmonellosis epidemiology, but, nevertheless, I believe that animal salmonellosis today no longer represents primarily a voluntary

Descriptors

Salmonellosis
domestic animals
serotypes
reservoir
endemic infection
cattle
calves
fowl
swine
stall
pasture
market
typhoid fever
poultry
meat meal
excreta
epizootic
soil
manure
sheep
goats
epidemiology
S. cholerae-suis
food poisoning
mutton
urine
excrement
horse
water-born
turkeys
fish meal
carrier-rate
typhoid fever
carrier
Paratypus A
Paratyphoid A
host
meat animals
chains of infection
S. bareilly
fodder
rodents
food
milk-born
chickens
rats
serotype frequency
waste water
sanitation
sewage disposal
S. typhi
fertilizers
dust
sewage
animal feeds
surface-water
bone-meal
sludge
Paratyphoid B
feeds
contamination
food poisoning
salmonella
communal feeding
S.Typhi-murium
S.chloerae-suis var. kunzendorf
S.bovis-morbificans
S.newport
S.heidelberg
meat
meat products
incidence
morbidity rate
bone meal
utensils

Abstract (continued)

medical problem, but preeminently one of public health!

Page 173 -- Cattle and calves were for a long time the most important carriers of salmonella among meat animals. However, in many countries they are less important than fowl or swine in regard to frequency of infection.

Page 177 -- Infection of adult cattle can occur in the stall, at pasture or in the market. The clinically healthy excreter is to be considered as the chief source of infection.... A real minor epizootic can develop from these excreters by spread to stall-mates.... However, the usual course is the sporadic appearance of the infection in one or several animals among the animal population. (Field[38]). A further possibility of infection, especially in lowland regions with frequent inundation, arises from the pasture and fodder harvested from such pastureland. (1, 7, 22, 67, 71, 93, 103). The carrier animals at pasture augment the contageousness of the soil with their droppings and there ensues a water-soil-cattle-water contamination cycle. A further contamination of the soil from manure of animal or human origin arises. While salmonella-containing industrial manure, whose organic material is usually mixed with chemicals, seldom becomes of epidemiologic importance. The greatest danger from organic fertilizer is to the worker[131].

Page 178 (First paragraph) -- (Salmonella ...remain viable in contaminated soil or on grass 150-307 days; in manure splattered on walls, up to 10 months; in infected manure, they apparently die by the end of 6 months. However, Field found living salmonella in dried cattle manure after 1000 days.

Page 185 -- Both sheep and goats play a small role in salmonella epidemiology in spite of the comparatively large numbers of sheep. Cases of food poisoning after consumption of mutton is practically unknown(Köller); however, Wilson et al., found Salmonella in 3% of mutton examined in Cincinnati retail markets. The increasing isolation of salmonella in swine and fowl is especially striking. Throughout the world, swine are highly important carriers of salmonella. (14, 32, 63, 104, 106, 119).

Page 187 (Second paragraph) -- It is surprising that S. cholerae-suis infection in swine does not lead to more frequent infection in man. Swine become very easily infected (with salmonella species adapted to them) by direct and indirect contact. Excretion (of the organism) then follows in bronchial mucus, urine, and, less frequently, in the excrement. (Note: The swine salmonellae are further discussed on page 185 ff; fowl infections on pp 190-193; and horse infection, 193-4).

Page 205 -- Transmission of Salmonellae and Pathogenesis of Salmonellosis in Man - F.N. Sickenga - The Hague. See especially page 210. (in English)

Pages 245-294 -- Epidemiologie der Salmonelloses in Europa (ausgenommen Osteuropae) [Epidemiology of salmonellosis in Europe, with the exception of East Europe by HPR Seeliger with collaboration of A.E. Maya - Hygiene - Institut der Universitat Bonn/Rhein.

Page 246 -- Typhoid Fever -- The epidemiologic picture is determined by the known means of infection (the primary source of infection is always the infected person -- patient, carrier, excretions, feces, seldom urine). Transmission

Abstract (continued)

follows in part through contact, but chiefly by means of polluted water and food. Primitive living conditions and insufficient waste disposal are major factors in epidemicity.

Page 256 -- Epidemiologic Conclusion and Outlook. The development of typhoid incidence in Europe shows that the geographical distribution of typhoid fever is dependent on the standard of living and general hygienic conditions of the state. Every improvement of the general situation usually leads to a reduction in the spread of typhoid fever; every worsening to the opposite.

Page 258 -- Paratyphus A The method of infection for Paratyphoid A is essentially the same as that for typhoid fever in that here also man is to be regarded as the true reservoir.

Page 260 -- Paratyphus B Man is the primary source of infection in the great majority of cases; however, S. paratyphi B is occasionally excreted by animals and transmitted by means of food. This last occurs but rarely in Europe; however, the antigenically similar S. java frequently occurs in animals and can cause infection in man.

Page 263 -- Epidemiologic conclusions and outlook .

Page 263-264 -- In contrast to typhoid fever and Paratyphoid A, Paratyphoid B is endemic in all of Europe. This expresses itself in late summer and fall in numerous isolated cases and outbreaks. Although for the most part these are limited as to locale, occasionally (chiefly through food poisoning) they lead to extended epidemics of which the most extensive occurred in Sweden in 1953.

Page 264 -- Paratyphus C The means of infection by Paratyphoid C is determined by the fact that its agent, especially the Kunzendorf type, belongs to those salmonellae whose host is to be sought in meat animals (especially swine) rather than man. According to Bader, at least in certain regions, spread of infection through the urine of infected individuals is of the greatest importance.

Page 265 -- Epidemiologic Conclusions and Outlook. Summarizing, it is to be concluded that, in the region of Europe discussed here, Paratyphoid C is not endemic and is observed only exceptionally; it is always a matter of imported infection.

Page 266 -- Other Salmonellae - Origin of Salmonellae in Europe In contrast to the agents of typhoid and paratyphoid fevers ----,the remaining salmonellae comprise a large number of bio-, sero-, and phage-types. Of these, nearly a thousand serotypes alone have been described. A significant part of these types were first identified in Europe; however, Europe itself is not to be regarded as the real place of origin for most of these organisms. For more often, it is a matter of species imported (and yet to be imported) from tropical countries.

Page 267 -- Host, infectiousness, and symptomatology. As distinct from the above described disease agents, the primary host of the remaining Salmonellae is to be found in the animal kingdom. Depending on changing circumstances, these organisms, according to the animal species, cause enteric or septic infections as well as carrier-states and suceed only secondarily in infecting man through comsumption of infected food. The ingestion of only a small number of organisms can be without clinical effects, but lead to a more or less enduring excretion in human excrement with all of the ensuing epidemiological consequences.

Page 267-268 -- A number of epizootically important salmonellae are so adapted to a particular host, that its transmission to another host such as man never, or only exceptionally, leads to clinically manifest consequences.

Abstract (continued)

Page 268 -- The Chain of Infection. It would be going too far in this section to treat in detailed fashion all of the external and internal chains of infection in the manner of Gotschlich, Habs et al, especially since this can be obtained from other chapters. In Figure 5, the attempt is made to bring the mode of infection presently prevailing in Europe under a simplified general common denominator. (See chart on page 269).

Page 271-2 -- Occasionally a massive outbreak of salmonellosis among humans occurs from a spread of latent infection in animals by labrinthine pathways. As an example of several such outbreaks, might be mentioned the extensive epidemic of S. bareilly in the north of Germany consisting of over 10,000 clinical cases. They were caused by Camenbert cheese which had become infected from salmonella containing glue or the labels pasted on (the cheese). This glue had been contaminated by a S. bareilly excreter who lived and worked on an estate where swine had been raised on protein fodder containing S. bareilly.

Page 272 -- All these infection-chains run by different pathways into waste water and drainage channels whose salmonella content in Europe furnishes a picture image of the increasing infection of man and animal. Finally, it should be mentioned that salmonellae are found with varying frequency in artificial manures.

Page 273 -- Rodents, with their own salmonella epizootics, but also as transmitters, have always played a considerable role in the salmonella infection cycle among stabled cattle and, by roundabout pathways through foodstuffs, in human infections.

Page 286 -- Salmonellosis in Infants -- Method of Infection. Usually the infection in infants and young children is caused by food or contaminated materials...Of most importance are secondary infections of prepared foods (caused by), man, waste water, or soiled kitchen utensils (Schmidt).

Page 299 -- Salmonella infections in East Europe. Kazimierz Lachowicz, State Institute of Hygience, Warsaw. "A very serious problem in the control of typhoid is sanitation, especially that of the water supply and the sewage disposal in the geographic regions where water sources are scarce and people are forced to use surface water (e.g., some middle Asian republics of the U.S.S.R.)"

Page 353 -- Les Salmonelloses en Afrique (Salmonelloses in Africa).

Page 378 -- Conclusion: The distribution of serotypes of salmonellae in the countries of Africa cited in example --- permits certain comparisons to be made and certain analogies to be placed in evidence:

S. typhi is the most frequent serotype in man;

S. paratyphi B. is relatively rare in Africa;

The distribution of S. paratyphi C. and S. cholerae-suis undergoes large fluctuations according to country;

Some serotypes, not present in some countries are very frequent in others;

A certain correlation exists between the distribution of serotypes in meat animals, domestic animals, cold-blooded animals, and in man.

Abstract (continued)

(In English) As in the case of salmonellosis the transmission from animals to man (as a rule by animal food) is much more frequent than that from man to man or from man to animals, there is reason to expect that eradication of the salmonella-reservoir in animals will lead to a very important reduction of salmonellosis in man.

This does not mean that transmission from man to man is impossible, and it happens now and then indeed, but is epidemiologically less important than that from animals to man. This transmission is seldom direct; as a rule man contracts it by eating contaminated meat or animal products. Sometimes other substances than food or drinking-water have to be considered as sources of contagion, e.g. manure or organical fertilizers and dust.

Besides transmission by food, transmission by direct contact is also possible, as well from man to man as from animal to man. Epidemiologically, this way of transmission is less important than that by food, but not altogether negligible. The danger of contagion by direct contact with adults must be small, as was proved by McCullough & Eisele[17,17a], in their experiments with volunteers (prisoners). Only in certain circumstances, e.g. when mothers and their babies are concerned, the danger of contagion by direct contact is greater, as well between themselves as regarding other persons in their neighbourhood.

Transmission by other media. Salmonellae have been found in animal feeds, manure and other fertilizers, dust, sewage and surface-water.

Imported animal feeds are not seldom contaminated with salmonellae (Kampelmacher & Guinee[27]: Rackow & Wiese[28]). It is probable that contagion of the people handling them happens now and then, but presumably not to such an extent that illness follows. The same applies to manure and other fertilizers.

Fresh excrements of farm-animals, and especially of pigs often contain salmonellae, but in manure that is allowed to heat in a dung-hill they die as a rule within a few days, except during rather severe frost (Paetgen[60]).

Other organic fertilizers may also contain salmonellae, e.g. bone-meal (Walker[26]) and sludge from sewage-disposal plants (Noordam[19]).

The importance of the presence of contaminated dust as a source of contagion in a children's ward was firmly established by Bate & James[40]. In this case dissemination by food or by human carriers could be excluded. The authors described an epidemic of salmonellosis, caused by S. typhi-murium phage type 2 in a ward, used for the isolation of infants under one year of age not suffering from gastroenteritis. This epidemic lasted eleven months, althoug the ward was closed several times, and washed down and disinfected thoroughly before being reopened. All feeds were prepared in a central milk-kitchen which operated under constant bacteriological control and which supplied feeds to other wards unaffected by the infection. During the epidemic all children were isolated in single cubicles. Moreover the whole medical, nursing and domestic staff, and the porters of the hospital were examined. In the beginning some symtomless excreters were found among the personnel, but during the last four outbreaks no human carrier could be detected. Nevertheless ever and again new cases of gastroenteritis occurred among newly admitted children, and each time S. typhi-murium, phage type ", was cultured from the stools. At last this type was found in abundance in the contents of the dust-bag of a bacuum-cleaner that had been used constantly in the ward; the bag had been emptied infrequently. The epidemic ceased when the dust was collected in disposable paper-bags that were destroyed after each cleaning. The salmonellae still remained viable in the original dust-bag 10

Abstract (continued)

months after the removal of the last case from the ward.

In this context we have to consider the question whether respiratory infection plays a role in human salmonellosis-pathology. This question is still open; the possibility cannot be absolutely discarded.

It was proved that animals are liable to direct infection of the respiratory tract when they are exposed to an aerosol containing salmonellae even in a lower dose than that required for enteral infection.

Clemmer et al[30] succeeded in inducing salmonellosis in chickens by exposing them to a spray containing extremely small quantities of salmonellae; in some experiments not more than 20 germs sufficied. For infection per os quantities of bacteria were required that were a 100 to a 1000 times greater. Especially after inhalation of small quantities of S. pullorum extensive foci of pulmonary infection were seen.

Darlow et al.[30] could induce extensive pneumonitis in mice exposed to an aerosol containing S. typhi-murium. The quantities of bacteria used in these experiments were much larger than those administered to the chickens, but also in these animals the lethal dose by inhalation was much smaller than that required in case of ingestion.

In man, salmonellae have been found in the upper respiratory tract, and also cases of salmonella-pneumonitis as a sole or preponderant site of infection have been observed, although rather seldom.

Among 7779 cases of salmonella-infection in man, identified at the New York salmonella Center, there were 572, where focal infections were the predominant and frequently exclusive clinical signs, and 85 of them were localized in the respiratory tract, mostly as a lobar pneumonia or a bronchopneumonia. The type of salmonella most frequently found in these cases was S. cholerae-suis, followed by S. typhimurium. A great deal of the patients were aged people, or persons who suffered from other diseases (Saphra & Winter[35]). In a few cases there was a salmonella-tonsilitis or otitis media.

When salmonella-pneumonitis occurs in man, the route of infection of the lungs is not clear; it may be as well aerial as hematogenic.

Winding up the argument, we conclude that salmonella-contaminated dust or sprayed droplets may cause contagion of human individuals, and that this contagion sometimes leads to infection. But we don't know exactly what is the link between the two. It is possible that different routes are followed in different circumstances.

Paratyphoid A has been only rarely met with in Czechoslovakia, Hungary, Yugostavia and Bulgaria after World War II. In Czechoslovakia an epidemic of paratyphoid A was notified in a mental hospital in 1948 with 37 cases involved[19]. There were three other paratyphoid A cases reported since, one in 1954 and two in 1961. No paratyphoid A epidemic has occurred in Hungary, Yugoslavia or Bulgaria, and only few sporadic cases. More affected have been Poland, Roumania, and U.S.S.R. In Poland about 40 paratyphoid A cases a year were confirmed bacteriologically in 1945-1956[20].

Paratyphoid B is the main paratyphoid problem in all of East Europe. In Czechoslovakia, Hungary, Yugoslavia and Bulgaria it is practically the only paratyphoid problem of the country. Therefore, what has been said of the paratyphoid problem as a whole, relates to paratyphoid B. Thus, paratyphoid B seems to be in retreat almost everywhere except for Yugoslavia. However, in most instances

Abstract (continued)

the typhoid fever incidence decreases more quickly than that of paratyphoid B, and perhaps the time is ahead when the paratyphoid B problem in East Europe will be as important as the typhoid one, whatever their future weight may be.

Paratyphoid B epidemics occur in all the countries, chiefly water-born or milk-born, but the bulk of the paratyphoid incidence is formed by sporadic cases. Usually they are not evenly distributed all over the country.

Paratyphoid C is from the epidemiological point of view certainly the least important paratyphoid problem in East Europe. As far as is known to the author no paratyphoid C case has been reported from Czechoslovakia, Hungary or Bulgaria since World War II, and probably no one in the interwar period either. Only one case of a healthy paratyphoid C carrier was registered in Czechoslovakia (Slovakia) in 1955[55].

Salmonella organisms remain one of the most important bacterial agents, if not the most important one, in both outbreaks and sporadical cases of food poisoning in East Europe. It has been often stressed that the most characteristic actual feature of Salmonella food poisoning in Eastern European countries is the growing number of cases per outbreak, the growing number of Salmonella types involved, and a growing proportion of sporadic cases.

The growing number of cases per Salmonella food poisoning outbreak may be explained by the expansion of communal feeding. The other two characteristics must be regarded as closely related to the ecological aspects of salmonellosis, various "new" Salmonella types being more and more often encountered outside man too.

Salmonellas constitute the most important bacterial agent in food poisoning in Poland, the next one being staphylococci with less than a half of the number of outbreaks esp. cases due to salmonellas[83]. In 1951--1956 the number of food poisoning outbreaks registered amounted to 512 with 20944 cases involved[84]. Of these 146 were known as due to salmonellas (28.5%) with 3553 cases involved (26.5%). From 173 salmonella food poisoning outbreaks recorded in Poland in 1946--1956 as many as 129 were due to S. typhi-murium (74.5%), the next being S. enteritidis (12.0%), S. dublin (5.8%), S. heidelberg. Meat or meat products were incriminated in 65.3% of the outbreaks, in 31.2% of the outbreaks the invection sources remaining unknown. About 30% of salmonella food poisoning outbreaks occurred during the warm months of the year (V-IX).

Before World War II typhoid and paratyphoid incidence in the U.S.S.R. had decreased to a level of about 50 cases per 100,000 population, as judged from figures available in respect to the Ukrainian S.S.R. in 1940[85]. There was a great increase in typhoid and paratyphoid incidence during the war but it ceased soon, and not only the inter-war level but also a further decrease in the incidence has been achieved. It may be illustrated again by the typhoid morbidity rate per 100,000 population in the Ukrainian S.S.R., which amounted to 57 in 1947, to 18 in 1950, to 13 in 1953, and to 12.3 in 1956. A decrease trend like this, however, has not been observed in all the republics. As a result the average typhoid morbidity rate for all the country in the mid-fifties constituted about a half of that in the last inter-war years[86], probably about 25 per 100,000 population. The decrease trend ceased in the fifties.

It has been stressed in relation to the Russian Federal Republic which comprises more than one half of the country's population, that about 2/3 of all food poisonings are of bacterial origin, and that approximately 9-12% of those are due to salmonellas[93].

Abstract (continued)

S. typhi-murium was the Salmonella type most often met with in food poisoning in the U.S.S.R., in fact in more than 50% of cases. The next most common, *S. enteritis* and *S. cholerae-suis* (probably var. Kunzendorf) were a fourth of that number each.

There are many various reports on salmonella food poisoning in the U.S.S.R. with many fragmentary figures or other data. In all the opinion is rather generally shared that enteric disorders of salmonella origin grow in number and so do sporadic cases of the condition. A significant incidence of healthy carriers detected among food handlers has been reported too[45,46].

Hungary enjoys a rather good position as to the typhoid incidence, showing a steady decrease trend; its paratyphoid incidence is not high, but no definite decrease trend has been observed so far. Salmonella food poisoning seems to be a growing problem, but its more precise evaluation will be possible when more progress in notification of the condition is achieved.

As may be seen from table V the typhoid incidence is gradually declining in Roumania and since 1958 the morbidity rate per 100,000 population has always been under 10. Paratyphoid incidence is quite low and constitutes about 1/15-th of that of the typhoid fever. It may be calculated for salmonella food poisoning in Roumania that the average annual morbidity rate in 1951--1956 amounted to about 8 per 100,000 population. This is quite certainly much more than formerly, but the calculation was based on figures related to outbreaks only, sporadic food poisoning being probably unnotifiable at that time.

This is to a certain extent an exception among the Eastern European states as there has been only little change in its typhoid-paratyphoid morbidity rate during the last 40 years (see fig. 1). If, however, typhoid and paratyphoids are considered separately, a decrease of the typhoid incidence and an increase in the paratyphoids is apparent (table VI). No data for a tabular presentation of salmonella food poisoning incidence could be found. Salmonella food poisoning appears to be a growing health problem in all of East Europe but Bulgaria.

Israel -- Staphylococci preponderate in home-outbreaks, while Salmonellae are mainly responsible for outbreaks in kibbutzim as well as farms as causal agents of good-poisoning. The sources of Salmonellae are human carriers, clinical cases or domestic animals, used as pets or sources of food.

Salmonellosis in Canada by E. T. Bynoe & J. A. Yurak

At the beginning of this century "enteric fever" was a very common complaint in Canada, and as Dr. A. H. Gordon, a leading physician in Montreal at that time, said in an address in that city in 1922[1] was "for years the commonest medical disease in Montreal hospitals". In this respect, Canada was no different from most other countries. With the improvement of sanitation and hygiene, the wider distribution of pure (treated) community water supplies and of pasteurized milk, the limited use of T.A.B. vaccines, improved methods of bacteriological diagnosis and a concerted effort on the part of medical officers of health to search out 'carriers', the enteric fevers -- typhoid and paratyphoid -- have been slowly but steadily decreasing, while the less pathogenic streains of salmonellae, dependent possibly on other means of transmission, have been actually increasing in the country. During the last year, 1962, the Bureau of Statistics reported only 268 cases of "typhoid and paratyphoid" for all Canada (including Newfoundland) or a rate of only 1.5 per 100,000 population.

Abstract (continued)

While it is probable that most cases of typhoid fever are reported, it is also probable that many cases of less severe paratyphoid fever are not. While there has been no increase in the strictly human parasites of the genus -- *S. Typhi*, *S. paratyphi A* and *S. paratyphi B* -- there is a very marked increase in those members of the genus which are parasites of both man and animals.

While the case and the symptomless carrier are the primary sources of those salmonellae which are specific for man viz. *S. typhi*, *S. paratyphi A* and *S. paratyphi B*, animals particularly poultry appear to be the principal reservoir of most of the other important salmonella infections in man, viz. *S. typhi-murium*, *S. thompson*, *S. heidelberg*. Strict isolation and quarantine of 'typhoid - paratyphoid' cases and carriers and prevention of these shedders of typhoid-paratyphoid bacilli from contaminating water, food and their environment are the only effective measures of control. Active programs by medical officers of health to search out these carriers, particularly amonst food handlers, have been largely successful in slowly bringing these diseases in Canada under control.

This type of control program, however, has proven ineffective in controlling those other types of salmonella infections, in which the natural reservoir of the salmonellae is the animal population. The rapid and marked increase in *S. thompson* and *S. heidelberg* infections in man in recent years is clearly related to their presence in very large numbers in foods which have been prepared for general widespread use in the Canadian home. The sources of these food contaminants is the infected animal from which the food is produced -- poultry and eggs being the chief offenders. An intensive search during recent years of a number of human foods on the market, particularly egg-containing processed foods has revealed a large number of Salmonella types. The majority of these are shown in Table III. The finding of large numbers of salmonellae in many prepared animal foods (bone meal and the like) is probably likewise responsible for spreading much infection among the animal population. Successful contol is therefore in large measure dependent on stopping the spread of infection among the animals which are to be used for food, and on better processing and handling of the food prepared for human use. Successful control therefore requires the active participation and combined efforts of the veterinarian, the epidemiologist, the bacteriologist, the food processor and handler, and the sanitarian.

Epidemiology of Salmonellosis in the United States by Mildred M. Galton, James H. Steele & Kenneth W. Newell

A variety of Salmonella serotypes were widely distributed in the human and animal populations. In a study of 12,331 cultures, Edwards et al.[8], reported that types which occurred in both man and animals were recognized in 95% of the cultures from man. These studies emphasized that members of the Salmonella group were widely disperse; that they were possibly connected in a zoonotic cycle; and that further epidemiological and other studies are required to define the significance and magnitude of the salmonella disease problem in man and animals, and to develop preventive and control measures.

Dauer[13] and his associates published an annual summary of disease outbreaks in *Public Health Reports*. They estimated that no more than one in 20 cases of salmonellosis were reported, and suggested several reasons why some States reported poorly or not at all. First, some health authorities failed to understand the

Abstract (continued)

need for investigation and reporting and felt that there were more imporant problems. Second, some States possessed only limited personnel to conduct epidemiological investigations. Another factor may have been poor liaison between State and local health authorities.

In the United States, as in many other countries, it is usually only the large outbreaks of salmonellosis that are reported to health agencies, and in many instances, the etiological agents are not determined adequately. In considering the reported outbreaks of salmonellosis compared to those caused by staphylococcal enterotoxin and outbreaks of gastroenteritis of undetermined etiology, the need for more complete reporting and investigation is further apparent.

There has been little work to suggest that the non-typhoid salmonellae in humans are regularly perpetuated by a closed human transmission mechanism. On the other hand, paths of transmission from animals to man, with an increase in the number of organisms in transit, have been shown on a number of occasions. This incomplete and presumptive evidence leads us to believe that it is probable that the main reservoir of non-typhoid salmonellae is in animals, and that they are transmitted to man either directly, or indirectly in animal or animal contaminated products, incidental to the main cycle.

We believe that between 1934 and 1947, more investigations were being conducted upon poultry than upon other domestic animals but that it is still probable that poultry are a major reservoir. While S. pullorum and S. typhimurium are the most common types, a greater number of Salmonella types have been isolated from fowl than any other species except man. The majority of these have been found, also, in humans.

Salmonellae were recovered from beef livers which served as the basic food in a veterinary hospital where 70% of 40 dogs with diarrhea were positive for the same types. The livers were obtained locally and included those rejected for human consumption[66]. Transmission of infection to man from infected cattle has occurred primarily through consumption of raw or improperly pasteurized milk and milk products. In addition to our food producing animals, salmonella infections are prevalent in domestic pets that live in close association with man.

A few human infections have been reported due to contamination of food by rodents. Salmonellae have been found, also, in snakes, lizards, tortoises, and insects such as flies and cockroaches. Although the house fly is another vector of salmonellae and has been found to be capable of depositing large numbers of these organisms on food by defecation and regurgitation, the observations of Watt & Lindsay[9], in their fly control studies, indicate that they are of more importance in the transmission of shigellae than salmonellae.

There is increasing evidence that widely distributed animal feeds are heavily contaminated with salmonellae and provide a means for the extensive spread of infection now apparaent in domestic animals and fowls. Recent evidence indicates that a high proportion of both domestic and imported bone meal, meat meal, fish meal, and similar protein supplements used in animal and poultry feeds are contaminated with salmonellae. Numerous serotypes have been isolated.

(Title page missing) ...Rats

Rats are recognized as being generally fairly susceptible to Salmonella infections and develop severe typhoidal disease. They live in very close

Abstract (continued)

association with human life. There are, therefore, many possibilities not only for human but also domestic animal infections derived from rats carrying Salmonella and transferred by direct or indirect contacts. In particular, the behaviour of rats is an important factor in the contamination of food utensils with infected excreta, etc. The carrier-rate and serotype frequency of Salmonella in rats remained urinary or faecal carriers for long periods and Fenner & Jackson (1946) suggested that carriers were important as a reservoir of infection.

A major outbreak of gastro-enteritis in young children occureed in Brisbanae, Queensland. Mice and cockroaches found harbouring the Salmonella, were considered to be innocent victims of the environment and not original carriers, though they probably played some part in spreading the infection.

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Disease/Solid Waste Abstracts

No. DSW- 325

Author

H.G. Page, C.H. Wayman, and J.B. Robertson

Title

Behavior of Detergents (APS), Bacteria, and Dissolved Solids in Water-Saturated Soils

Reference

Geological Survey Research

Doc. No.	**Contract No.**	**Date issued**
Art. 237 of Paper 450-E; p.E179-181		1962

Abstract

In our study, the comparative effectiveness of a coarse-grained, a fine-graired, and a colloid-coated soil in removing ABS, dissolved solids, and bacteria from sewage effluent was determined under saturated-flow conditions. The coarse sand, pore clogging increases uniformly in the direction of water flow. In fine-grained soil, pore clogging apparently develops in anerratic pattern along the more permeable channels. After 71 days of operation, pore clogging was minor in coarse sand, but after only 15 days it was serious in fine-grained materials.

In summary, coarse sand and sandy loam removed about 90 percent of the bacteria from sewage within a few feet of travel, but additional travel does not necessarily remove all the remaining bacteria. Dissolved solids and detergent content (APS) virtually were unaffected by filtration of saturated flow. Because bacterial clogging occurs quickly in fine-grained soils, coarser sand is preferred as a pollution filter for the removal of bacteria.

Descriptors

detergents
solids
soils
alkylbenzenesulfonate (ABS)
dissolved solids
bacteria
saturated-flow conditions
filtration
apparatus
alumina
soils

Disease/Solid Waste
Abstracts

No. DSW- 326

Author

Henry C. Sweany, ed.

Title

Histoplasmosis

Reference

Doc. No.	**Contract No.**	**Date issued**
		1960

Abstract

The studies of Zeidber et al. in Tennessee (34) and continued experience in northern Virginia (7,14) amply proved that it was the association with chicken droppings rather than the presence of rats which influenced the occurrence and distribution of Histoplasma in soil on the farm where the original isolations were made, as well as on many other farm premises. All the known evidence points to a saprophytic reservoir of the fungus in soil or organic debris from which both men and animals (when exposed and susceptible)are infected.

The saprophytic association with chickens need not be immediate in time or space. Histoplasma has been isolated from chicken coop litter deposited in small piles on an exposed hillside many weeks before (7,10), from garden soil fertilized with chicken manure (20) and from underneath blue-grass sod on the site of a chicken house torn down and removed three years previously (7). Follow-up studies of these materials and sites to determine precisely how long Histoplasma can surviv under such conditions have not yet been reported.

Although the association between the presence of Histoplasma in soil or organic debris and the presence of chickens has been shown in many studies, this association is neither necessary nor constant. Histoplasma was isolated repeatedly from the inner walls and the foundation ledge near the base of an old silo (unused for many years) in which birds had nested and from which members of a farm family were infected while cleaning the silo. Histoplasmosis then must be considered to be a disease of nature, peculiarly localized to certain regions of the country and spread to humans from some reservoir in the soil or in nature. The production of spores is enormous.

There is no question that H. capsulatum is disseminated in the air. The

Descriptors

chicken droppings
saprophytic reservoir
fungus
soil
organic debris
histoplasmosis
manure
Histoplasma capsulatum
spores
air-borne route
geographic localization
river valleys
humidity
temperature
winds
tornadoes
coccidioidomycosis
inhalation
respiratory tract

Abstract (continued)

infection of persons in the laboratory in which the air-borne route is the most probable method of infection thoroughly demonstrates the dissemination of the organism by this route. The prevalence of high rates of infection along the river valleys of the Ohio, Missouri and Mississippi rivers has long beed cause for comment, indeed, this geographic prevalence along the river valleys may be carried to many of the river valleys of the world. Another theory is that soil groups are the limiting factors in the geographic prevalence of the disease. The preference of the fungi for moist humid conditions and warmer temperatures is well known. The growth of Histoplasma does seem to be affected by certain temperature and humidity conditions.

The presence of the prevailing winds actually brings to mind another question, and that is how is the disease spread about in nature? There are about three theories in this regard; the first being that of spread by the prevailing winds; the second that the spores are carried by floods along the river valleys and then after recession of the flood waters the organism is disseminated bv the wind from the dried up floodland. Still another theory is that of Manos (40) who postulated that tornadoes were important in dispersing the organism about in nature.

The problem of the limitation or dissemination of the fungus throughout the environment may also be approached by consideration of where people get infected. The basic question here is whether people become infected by the fungus blowing about generally through the air or whether they become infected by visits to, or contacts with local sources where the fungus is growing. This first method of infection is commonly regarded to be that which occurs in coccidioidomycosis where wind-blown dust contaminated with spores is regarded as the method of infection and it is considered that this infection can be acquired at any place throughout the broad expanse of the endemic area. With histoplasmosis this theory is by no means proved.

That most patients are infected by the air-borne route is supported by the epidemics where the air-borne inhalation of spores was related to activities at the point source. The duration and degree of exposure was correlated to the severity of illness and the frequency of lung lesions. The organism has been isolated from the air in areas where epidemic cases had occurred. Animal experimentation clearly indicates that the most infectious route for Histoplasma capsulatum is via the respiratory tract. Mice infected with as few as 10 spores regularly showed lesions and disease in experiments performed by Grayston and others in our laboratory (9).

Our present knowledge points to the soil, particularly where enriched by chicken droppings, as the major source of infection. Consequently, one would expect the highest incidence among five to fifteen-year-old children, since this is the age group with greatest exposure to the soil while still non-immune. Newcomers from areas of low endemicity will also be particularly likely to have primary infections, regardless of age.

Disease/Solid Waste Abstracts

No. DSW- 327

Author

William B. Herms

Title

The House Fly in i's Relation to Public Health

Reference Agri. Experiment Station
University of Calif. at Berkeley

Doc. No.	**Contract No.**	**Date issued**
Bull. 215, pgs. 513-533		1911

Abstract

There have no appeared literally hundreds of isolated papers relating to the transmission of disease by insects, and we are at this time obliged to recognize the new subject which we term Medical Entomology.

The expense to the United States incurred in the purchase of fly traps, sticky fly paper, fly poison and the like, must certainly exceed two millions of dollars annually, while Howard ('09) estimates the cost of screening at over ten millions of dollars per annum. The commercial value of a human life is estimated on the average at three thousand dollars. The decrease in the vital assets of this country through typhoid fever alone (much of which is transmitted by the house fly or typhoid fly) amounts to $350,000,000.

In habit the house fly is revoltingly filthy, feeding indiscriminately on excrement of all kinds, on vomit and sputum, and is, on the other hand, equally attracted to the daintiest foods of man, and will, if unhindered, pass back and forth between the two extremes.

Circumstantial evidence against the house fly as a transmitter of such infectious diseases as typhoid fever, tuberculosis, dysenteries, and cholera is complete as summed up thus: First, it possesses the best possible structures for the conveyance of "germs" and filth; second, it possesses the habit of feeding on excrementous matter of all kinds, vomit and sputum; third, the causative organisms ("germs") of the above-named diseases are present in the matter mentioned in the second clause; fourth, the house fly is the principal fly found in dwellings, alighting upon the prepared food of man, or on food products in grocery stores, fruit stands and meat markets.

A second series of experiments was carried on as follows: During the midde

Descriptors

transmission of disease
insects
cost
typhoid fever
house fly
excrement
sputum
foods
tuberculosis
dysenteries
cholera
Musca domestica
privy
pollution
dysentery

summer diarrhea
infants
tuberculosis
cholera
Staphylococci
eye disease
pink eye
Hippelates fly
leprosy
erysipelas
anthrax
smallpox
Yaws

Abstract (continued)

of May (1909) house flies were captured in various parts of Berkeley, placed at once in sterilized vials, and in the laboratory placed under bell jars with agar-agar plates all under sterilized conditions. After the flies had crawled about on the culture media, the latter was incubated for twenty-four house. In every case, but one, a strong growth of bacteria appeared. This one was incubated longer and after forty hours four centers of invection appeared. This fly had been taken on a sunny wall on one of the main streets, and having been under observation in this position for a long time (as reported by the assistant) it was first supposed that the action of the sunlight had sterilized it. This series of experiments included flies taken from a number of situations, namely principal thoroughfares, sunny walls, street corners, manure piles, and the dining-room. Without exception these flies were laden with bacteria, and in all cases the greatest care was exercised not to introduce any accidental infection on to the culture plates.

During the Spanish-American war flies with lime-covered feet were actually seen crawling over the food of the soldiers. The whitened feet were the result of lime and filth collected from the camp latrines. The depredations of typhoid fever at that time really mark the beginning of the widespread campaign against the house fly.

Typhoid bacilli have been isolated from house flies captured in houses in Chicago, in the neighborhood of badly kept privy vaults used by typhoid patients.

The writer's attention was called to a series of sporadic cases of typhoid fever, plausibly traceable to flies, thus: a certain carpenter recently recovered from typhoid fever, resumed his work, makirg use of a box privy, such as is often used in connection with buildings under construction. In the immediate vicinity there lived a milk dealer, who after washing his cans, placed them on the roof of a shed to drain and dry. Flies are fond of milk, even highly diluted with water. The cases of typhoid fever in question were, on investigation, found to be customers of this particular dealer. The argument is good and reasonably conclusive.

The pollution of the waters of New York harbor has been made the object of special study by Jackson ('09). In his report to the "Merchants' Association" of New York, he shows that the sewage is not carried away by the tides, and "that at many points sewer outfalls have not been carried below the low-water mark, in consequence of which the solid matters from the sewers have been exposed on the shores." These deposits were found to be covered with flies, thus affording . ample opportunity for the transmission of typhoid. It was, furthermore, found that the greater number of typhoid cases were found near the water front, and if the curve showing the prevalence of cases was set back two months it coincided with the curve showing the prevalence of house flies. The period of two months represents the time of incubation. The fly curve, of course, also coincides with the termperature curve, but hot weather alone cannot account for the dissemination of the typhoid bacillus.

Summer Diarrhea in Infants: A type of Bacillus dysenteria[3] is present in the stool of infants suffering from summer diarrhea. Thousands of infants die every summer from this complaint. It is well known that flies are strongly attracted by the stools from infants thus affected, and in the second place, consecutive to the argument, little children are greatly molested by flies, inasmuch as they

Abstract (continued)

often have milk vomits on their little dresses and around the mouth attractive to flies, and are quite helpless. How often does one see the house fly lingering menacingly around the mouth of the helpless infant.

Cholera was one of the first diseases with which flies were associated as transmitters, and the experimental evidence that has since been produced is no less complete than in typhoid fever. Without advancing the evidence as presented by Nuttall ('99), the following statement made by that eminent authority will serve the purpose, viz.: "The body of evidence here presented as to the role of flies in the diffusion of cholera is, I believe, absolutely convincing."

The pus forming or suppurative bacteria (Staphylococci) are largely carried by the house fly. Thus, the supperative eye disease of Egypt is said to be transmitted by the common house fly (Nuttall, '99), while Florida sore eye, or "pink eye," is evidently directly traceable to a little fly having mouthparts similar to the house fly known as the Hippelates fly (Nuttall, '99).

Disease/Solid Waste
Abstracts

No. DSW- 328

Author

Title

Problems in the Evaluation of Carcinogenic

Hazard from use of food additives

Reference

National Academy of Sciences

Doc. No.	**Contract No.**	**Date issued**
NRS Publ. 749	1960	

Abstract

Human carcinogens: oils, aromatic amines, inorganic arsenic compounds, chromates, asbestos, ultraviolet radiation, x-rays, radium, etc. In addition to the agents associated with cancer incidence in man, a large number and wide variety of substancees have been shown to be relatively potent carcinogens in experimental animals. These include some polycyclic aromatic hydrocarbons and certain of their derivatives, certain aromatic amines and aminoazo dyes, carbon tetrachloride, and urethan (7); senecio alkaloids (8); ethionine (9); thiourea; certain selenium compounds (10); dimethylnitrosamine (11); and 4-nitroquinoline N-oxide (12).

While there is no argument about the carcinogenicity of compounds such as those listed in the preceding paragraph, there is often doubt about the activity of some of the agents reported to be weak tumorigens or carcinogens. Of the more than 450 compounds for which acceptable evidence of tumorigenic activity has been presented, almost half (more than 200) are polycyclic aromatic hydrocarbons or their derivatives or analogs. More than 50 are azo dyes and a substantial number are aromatic amines or carbamates. Thus, a very large proportion of demonstrated tumorigens belong to a very small number of chemical types. Outside these groups a wide diversity of substances have been shown to have carcinogenic activity, e.g., cargon tetrachloride, the mustards, certain epoxides and ethylene imines, some dyes such as trypan blue, and others.

The most investigated group of carcinogens are the polycyclic hydrocarbons; of these, the most thoroughly studies are the potent compounds 3,4-benzpyrene (BP), 1,2,5,6-dibenzanthracene (DBA), 20-methylcholanthrene (MC) and 9,10-dimethyl-1, 2-benzanthracene (DMBA).

Descriptors

carcinogens senecio alkaloids
tars ethionine
oils thiourea
aromatic amines selenium compounds
inorganic arsenic compounds
chromates dimethylnitrosamine
asbestos, 4-nitroquinoline N-oxide
ultraviolet radiation
X-rays tumorigenic activity
radium 3,4-benzpyrene (BP)
polycyclic aromatic hydrocarbons
aromatic amines 1,2,5,6-dibenzanthracene (DBA)
aminoazo dyes 20-methylcholanthrene (MC)
carbon tetrachloride
urethan 9,10-dimethyl-1, 2-benzanthracene (DMBA)

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Disease/Solid Waste
Abstracts

No. DSW- 329

Author
M. Morellini and G. Sacca

Title Some Aspects of the Mechanism of Transmission of the tubercle bacillus by Musca domestica (Experimental Study)

Reference Reniconti instituto superiore de sanita

Doc. No.	**Contract No.**	**Date issued**
v.16 p. 267-85 #449.9 R66	1953	

Abstract

Summary: The following statements can be often read in the literature on M. domestica as spreading agent of t.b.c.:

1) Flies are particularly attracted by sputum, especially be t.b.c. patients sputum.

2) Flies that nourish themselves on t.b.c. sputum suffer of a form of diarrea.

3) Flies' vomit, as a t.b.c. spreading factor, is more important than flies' diarrea.

The authors have controlled these statements through a series of experiments, the conclusions of which are herewith summarized.

1) Flies are not particularly attracted by human sputum, originating from pulmonary affections. Flies seem to prefer the other types of nourishments used by the authors.

2) Groups of at least 100 flies were kept for 24 hours on a known diet. 33 types of diets have been used, 7 of which contained the bacilli and 3 of these consisted of sputum. The feces of each fly were collected. The number of dejections vary according to the diet, but it is not influenced by the presence of the bacilli.

3) A small paper cylinder has been applied to the abdomen of 80 flies in order to collect their feces. These flies were abundantly nourished and observed for at least 24 hours. No vomit spots were found on the glass cages while the paper cylinders showed to be full of dejections. It must be concluded that flies do not deposit on the resting surfaces the vomit drop, which appears on the proboscis after a meal. The authors interpret the production of this drop and its following reabsorption as a physiological step of the fly's digestive process.

Descriptors

tuberculosis
musca domestica
feces
transmission
flies
vomit spots
tubercle bacillus
sputum

Disease/Solid Waste
Abstracts

No. DSW- 330

Author

T. M. Rivers and F. L. Horsfall

Title

Viral and Rickettsial Infections of Man

Reference

Lippincott

Doc. No.	Contract No.	Date issued
		1959

Abstract

No attempt was made to prepare an annotated bibliography of this large text. The title is essentially explicit as to content. Of interest to the present study are the sections on epidemiology under each disease discussed. Quotations from the text are identified as to page in the study report.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW- 331

Author

Title
Excreta Disposal for Rural Areas
and Small Communities

Reference
World Health Organization

Doc. No.	Contract No.	Date issued
Mono. No. 39		1958

Abstract

Excreta disposal is an important part of environmental sanitation. Its provision is listed by the WHO Expert Committee on Environmental Sanitation among the first basic steps which should be taken towards assuring a safe environment in rural areas and small communities. In large areas of the world, and indeed in parts of every country, proper excreta disposal is among the most pressing public health problem.

The inadequate and insanitary disposal of invected human faeces leads to the contamination of the ground and of sources of water supplies. It often affords an opportunity for certain species of flies to lay their eggs, to breed, to feed on the exposed material, and to carry infection. It also attracts domestic animals and rodents and other vermin which spread the faeces, and it sometimes creates intolerable nuisances.

It is well known that there is a relationship between the disposal of excreta and the state of health of the population. The relationship is both direct and indirect in character.

The direct effect is exemplified by the reduced incidence of certain diseases when proper disposal of excreta is practised. This group of diseases includes cholera, typhoid and paratyphoid fevers, the dysenteries, infant diarrhoeas, hookworm disease, ascariasis, bilharziasis, and other similar intestinal infections and parasitic infestations. These diseases lay a heavy hand on infants, whose immunity is low and whose vigour is often not great enough to cope with an infection after it becomes established. Further evidence of this direct relationship may be found in a comparison of figures for infant mortality from diarrhoeas and enteritis in various countries.

Descriptors

- excreta
- disposal
- health
- human faeces
- flies
- rodents
- vermin
- cholera
- typhoid fever
- paratyphoidfever
- dysenteries
- infant diarrhoeas
- hookworm disease
- ascariasis
- bilharziasis
- intestinal infections
- parasitic infestations
- infant mortality

Abstract (Continued)

There is considerable evidence that the diminished incidence of excremental and water-borne diseases which results from improvements in environmental sanitation is accompanied by a marked decrease in morbidity from other diseases the etiology of which is not directly related to either excreta or contaminated water-supplies.

Anderson & Arnstein state that, in order to transmit disease, the following factors are necessary:

(1) a causative or etiological agent;
(2) a reservoir or source of infection of the causative agent;
(3) a mode of escape from the reservoir;
(4) a mode of transmission from the reservoir to the potential new host;
(5) a mode of entry into the new host;
(6) a susceptible host.

The absence of a single one of these six conditions makes the spread of disease impossible. In different parts of the world, different modes of transmission may assume various degrees of importance: in some areas, water, food, and milk may be most important; in others, flies and other insects; and, in still others, direct contact may assume a major role. What is most probable is a combination of all, and the sanitary worker must assume that this is the case and guard against all modes of transmission. The technical objective of sanitary excreta disposal is therefore to isolate faeces so that the infectious agents in them cannot possibly get to a new host.

A rapid investigation of sanitary conditions throughout the world would show how vast and important is the problem of excreta disposal. Even in countries such as Great Britain, France, and the USA, which by world standards may be considered prosperous and healthy, much remains to be done in this field. In the USA, it was conservatively estimated in 1943 that 4,000,000 sanitary privies were needed in rural areas to serve 16,000,000 people, who lacked these fundamental necessities and who, for the most part, resided in areas having the highest incidence of typhoid fever, dysentery, and hookworm.

In India and Pakistan, faecal-borne diseases rank high among the most important communicable diseases. In the decade between 1940 and 1950 the record shows that 27,438,000 persons died in India from the enteric diseases. The incidence of hookworm was between 40% and 70% of the population. In rural areas of North China, 81% of the population has been found positive for ascaris, and 76% was estimated to be positive for Entamoeba histolytica (amoebiasis).

After excreta are deposited on the ground or in pits, the bacteria, unable to move much by themselves, may be transported horizontally and downward into the ground by leaching liquids or urine, or by rain water. The distance of travel of bacteria in this way varies with several factors, the most important of which is the porosity of the soil. Their horizontal travel through soil in this manner is usually less than 90 cm (3 ft) and the downward travel less than 3 m (10 ft) in pits open to heavy rains, and not more than 60 cm (2 ft) normally in porous soils.

Abstract (Continued)

Gotaas and his co-workers, studying the artificial recharge of aquifers with reclaimed sewage and other waste waters in the State of California, USA, found that bacteria were transported to a distance of up to 30 m (100 ft) from the recharge well in 33 hours, and that there was a rapid regression of bacterial count over this distance due to effective filtration and to bacterial die-off. They also found that chemical pollution travelled twice as fast. Recently, other workers, studying ground-water pollution in Alaska, noted that bacteria were traced to a distance of 15 m (50 ft) from the dosing well into which test bacteria were introduced. The width of the path of bacterial travel varied between 45 cm and 120 cm (1.5 ft and 4 ft). Regression then took place and, after a year, only the dosing well remained positive for the test organism. These investigations confirm the findings of other workers to the effect that the contamination from excreta disposal systems tends to travel downward until it reaches the water table, then moves along with the ground-water flow across a path which increases in width to a limited extent before gradual disappearance.

In the Netherlands, Baars found that, unless accompanied by a considerable amount of water, bacterial contamination did not travel more than 7.5 m (25 ft) through find sand.

On the surface of the ground, only the earth immediately surrounding the faeces is likely to be contaminated, unless it is carried further by surface water such as rain and irrigation water, blown away by the wind, or picked up by the hair and feet of flies or other insects and animals.

The role of flies in the transmission of faecal-borne diseases has already been mentioned. The common housefly lays its eggs preferably in horse and stable manure, but will also do so in exposed human excrement and any other decaying organic matter. It crawls and feeds on this material, picking up filth and live organisms on its hairy body, as well as bacteria which pass unharmed through its alimentary tract and are often deposited later on human food. Besides the housefly, various other flies (bluebottle fly, greenbottle fly) may also breed in human excrement and decaying matter. In temperate climates, excreta-borne diseases are usually more prevalent during the warmer months when flies are most numerous and most active.

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**Disease/Solid Waste
Abstracts**

No. DSW- 332

Author

C. Horton Smith

Title

Biological Aspects of the Transmission of Disease

Reference

(Book) Olior and Boyd, London

Doc. No.	**Contract No.**	**Date issued**
	Haefner Pub., N.Y.	1957

Abstract

As for sporotrichosis, there is no evidence of spread of infection between man and man. Dispersal occurs during the saprophytic phase and man, particularly male agricultural workers, accidentally contracts the disease by the infection of minor injuries.

A striking example of a localized mycosis of high incidence is provided by coccidiodomycosis (Coccidiodes immitis), which is confined to certain arid regions of North and South America. This condition was first recognized as a serious and often fatal mycosis. One result of infection of men and animals with C. immitis is the development of a persistent skin sensitivity to extracts of the fungus. The incidence of coccidiodomycosis is highest during the dry months of the year (with peaks following dust storms) and lowest during the wet season and there is clear evidence that the reservoir is the soil. C. immitis is perhaps the most dangerous of all pathogenic fungi to handle in the laboratory for in the culture it produces vast numbers of dry chlamydospores which very readily become air-borne. As a consequence, infection of laboratory workers is not uncommon.

Another major mycosis of the United States is histoplasmosis (Histoplasma capsulatum) which in contrast to coccidioidomycosis is endemic in the central Mississippi Valley and the Ohio Valley. Like coccidioidomycosis, farm and domestic animals (both mannals and birds) are affected and it is believed that these, like man, contract the infection by the inhalation of dust derived from a reservoir of the fungus in soil.

Most of the evidence regarding the dispersal of fungi pathogenic for man and animals is circumstantial. The reservoir of a number of the major systemic mycoses is almost

Descriptors

- sporotrichosis
- coccidioidomycosis
- Coccidioides immitis
- pathogenic fungi
- histoplasmosis
- Histoplasma capsulatum
- anthrax
- urine
- faeces
- milk
- bacilli
- spores
- foods
- swine erysipelas
- Erysipelothrix rhusiopathiae
- birds
- sheep
- man
- helminths
- host
- ground
- faeces
- cattle
- soil
- Typhoid
- cholera
- paratyphoid
- staphylococci
- Clostridium welchii
- Bacillary dysentery
- flies
- Infantile gastro-enteritis
- summer diarrhoea
- arthropod
- poliomyelitis virus
- flies
- Coxsackie virus
- house flies
- mosquito
- yellow fever
- Eastern equine encephalomyelitis

Abstract (Continued)

certainly soil, and for these conditions air-borne dispersal of fungal spores or of contaminated soil particles appears to be characteristic. The port of entry of the soil-inhabiting pathogens is either the lungs (coccidiodomycosis, histoplasmosis) or a chance injury (madura foot) while their geographical localization may be determined by the distribution of soils or of environmental conditions favourable for particular fungi.

Anthrax is primarily a disease of animals and is widespread in certain countries, and in the countries in which it is endemic the maximum incidence occurs in the warm months of the year and in low lying, swampy areas. Spread of the disease from animal to animal by direct contact rarely occurs; there is some medium through which infection most usually occurs.

Infection takes place by the alimentary tract and the bacilli are excreted by the urine, faeces and possibly the milk during the latter stages of infection. Bloodstained infected fluid exudes from all orifices of the body at death, and the immediate surroundings may be heavily contaminated. The bacilli do not sporulate in the unopened carcass, but when the bacteria are exposed to atmospheric conditions spores are produced and these are resistant and may remain alive in or on infected soil for many, many years. Animals may therefore be infected by feeding on contaminated pasture land and the greater incidence of infection in swampy areas and during the summer months is associated with the development of the spores and the multiplication of the bacteria on the decaying vegetable matters in these areas.

In Great Britain outbreaks are associated with feeding imported, infected foods. The disease is therefore not only more common during winter months when artificial foodstuffs are used but is clearly more frequently observed amongst cattle which are fed on imported foodstuffs than amongst those cattle and sheep which are fed in a different manner.

Swine erysipelas is caused by Erysipelothrix rhusiopathiae. It is found not only in diseased pigs but also in birds, sheep and occasionally man; it may be recovered from the tonsils, gall bladder and gut of apparently normal, healthy pigs. These animals may be the main reservoirs of infection for swine erysipelas but in addition the organism is capable of remaining alive outside the animal body for considerable periods. There is, therefore, the suggestion that this organism may lead a saprophytic existence and that soil or water may be the main origin of this particular infection. Although some areas of ground are undoubtedly heavily contaminated with E. rhusiopathiae, it is much more likely that apparently healthy pigs are really the reservoir but that the organism may remain alive in these heavily infected areas for some months.

Information concerning the dispersal of parasitic amoebae is almost entirely confined to the pathogenic species Entamoeba histolytica, which infects man.

In general, amoebae have a simple life history in so far as no intermediate host is required for its completion.

Abstract (Continued)

Entamoeba histolytica

Cysts discharged with the stools are swallowed by a suitable host and hatch in the small and large intestine. In a proportion of infections, the amoebae invade the wall of the large intestine producing ulcers and causing symptoms of disease in the host. No cysts are formed until symptoms subside. The amoebae cannot survive outside the host and the species is transmitted by the cyst. Moreover the cysts must be kept moist as they are instantly killed by drying.

Acquisition of resistance before the hosts reaches maturity is largely a matter of numbers of parasites.

Another peculiarity concerning the helminths is their need for development outside the host, and in the instance of those with which I am dealing this development is on the ground. The infective form then must await the lucky chance by which it is picked up by the appropriate host. The specific responses of some grazing animals reduce the intake of infective larvae by causing them to avoid the proximity of the faeces of their own kind while grazing. Horses reserve certain parts of a field for grazing and certain other parts for defaecation and cattle will avoid the grass near to deposits of cattle faeces for weeks.

I must return to the non-biological agencies that lead to the ingestion of large numbers of infective eggs or larvae.

Where sheep are folded over crops on arable ground, and where they trample the infected faeces into the soil, an excellently damp and well aerated culture medium is provided under which conditions, infective larvae develop in large numbers. If this ground is ploughed and worked with harrows, it may still further assist, as the larvae through their own activities quickly regain the surface of the soil and in a loose tilth are protected against excessive dryness, which is the most lethal natural factor operating against their survival. They then climb on to the succeeding crop and not infrequently produce severe disease among the sheep that may be folded there.

A further example that might be mentioned concerns the lush pastures of our modern grass land, brought about by the specially selected grasses and clovers, and the extensive use of artificial manures; these pastures add to the dangers in two ways, firstly by leading to greater concentration of the grazing animals (as has been shown there is a tendency for the rate of infestation with parasitic worms to increase as the square of the numbers of grazing animals per unit area); and secondly, by aiding larval development. This increase is brought about not only by the moist microclimate in the dense shade of the long herbage but is often assisted by the diarrhoeic condition of the faeces of grazing animals resulting from the lush herbage.

With the exception of the filarial nematodes, the majority of which are inoculated by the bite of an insect, the infective stages of parasitic worms must passively await the lucky chance by which they are swallowed as a contaminant of the food of the specific host. Even those that have "learned" to make use of an intermediate host must possess an adequate power of resistance, in order to enable them to await the arrival of that host.

Abstract (Continued)

Intestinal infections are spread to a large extent by contaminated food and water, but contaminated fomites are probably important in the spread of such common infections as bacillary dysentery and infantile gastro-enteritis, while certain intestinal infections seem to be air-brone. Typhoid and cholera have long been the main examples of explosive water-borne intestinal infections.

In contrast to typhoid fever, paratyphoid is more commonly a food-borne infection and seems to require a medium in which it can multiply before it can produce infection. In this respect it comes nearer to the acute salmonella food-poisoning has its highest incidence in the summer months when opportunities for bacterial multiplication are optimal.

Bacillary dysentery, in contrast to food-poisoning has its peak incidence in this country in the winter and spring months. Food and water are rarely incriminated as vehicles for the spread of the infection. Instead, intimate contact in the home, in nurseries, and in schools, is an important factor in its spread, and contaminated fomites from contaminated hands probably play an important role in the transmission of the infecting organism. The infecting dose is a small one. In warmer countries than our flies play their part in the spread of bacillary dysentery.

Infantile gastro-enteritis, which predominantly affects artifically-fed infants living in poor-class urban areas or in institutions, used to occur in epidemics during the late summer months and was therefore called "summer diarrhoea." It is now much less common and less severe than it was fifty years ago and is spread evenly throughout the year. It is a highly infectious disease for infants under one year of age and spreads readily in hospitals and institutions despite high standards of nursing care and isolation procedures. The soiled napkin is probably an important source for environmental contamination; hands, dust and fomites (brooms weighing machines, etc.) rather than milk, seem to be the main vehicles for spread of the infection (Rogers 1951).

A large proportion of restrictedly human virus infection is spread from patients or carriers to others by the respiratory system. Animal viruses, for example those of psittacosis and Q fever, gain access to human tissues in this way and the persistence of the agent in the dry state in dust plays an important part. However, this portal of entry is relatively less common in the transmission of viruses from animal to man, especially if the role of arthropod vectors is also taken into account.

Claims have been made that biting flies could transmit poliomyelitis virus (Rosenau, 1912; Anderson and Frost, 1912) but McFarlan, Dick and Seddon (1946), and others have been unbale to confirm this either experimentally or on epidemiological grounds. The possibility that poliomyelitis virus might be transmitted mechanically to human beings by internal contamination of faecal feeding flies has attracted more attention (see Gear, 1952). Melnick and Penner (1952) found that they could detect virus from human sources in the bodies of house flies (*Musca domestica*) and blow flies (*Phormia regina* and *Phaenicia sericata*) between the fifth and seventeenth days, and in the excreta of these insects between the fourth and tenth days, after an infecting feed. On the other hand *murine* strains of virus could not be recovered beyond the fifth day. There is no evidence of multiplication of the virus in flies but whether or not the virus is carried purely mechanically is uncertain. Although most laboratory studies suggest that *internal* contamination of flies is a possible

Abstract (Continued)

mode of transmission of poliomyelitis, there is no evidence that it is of any epidemiological importance. The best field evidence in this respect comes from the work of Paffenbarger and Watt (1953) who clearly demonstrated that fly control instituted before and during an outbreak of poliomyelitis failed to reduce the number of cases or to affect the time course of an epidemic in fly-controlled cities.

Coxsackie viruses have also been found in house flies and in blow flies, and virus persisted in these species for one or two weeks (Melnick and Penner, 1952). There is no evidence that virus multiplies in them nor that infected flies play any part in the epidemiology of Coxsackie virus infections (Melnick, Emmons, Coffey and Schoof, 1954).

It is generally agreed that once a mosquito which is capable of biological transmission is infected, it continues to be able to transmit virus for the rest of its life, and there is no evidence that infection with an animal virus shortens the life of a mosquito. In general it may be said that with yellow fever and the equine encephalitides blood titres of 10^{-3} are required to infect 1 to 5 per cent (infection threshold) of susceptible *Aedes* mosquitoes and infection of 50 per cent of such mosquitoes may be achieved with titres of 10^{-5} to 10^{-6}. Congenital transmission of virus infections is not known to occur in mosquitoes.

The role which mites play in the transmission of virus diseases is not fully established. Congenital transmission of St. Louis encephalitis in chicken mites (*Dermanyssus gallinae*) has been reported and isolations of St. Louis and WEE viruses have been made from chicken mites taken in the field. Strains of EEE virus have been isolated from chicken mites and lice (*Eomenacanthus stramineus* and *Menopon pallidum*) and also from wild bird mites (*Liponyssus sylvarium*). In spite of numerous attempts only one claim of successful experimental transmission by the bite of mites has been made. These findings suggested that mites which had been infected congenitally, or mites or lice infected by feeding on an infected bird might infect nestling birds or newly hatched fowls and that these birds in turn might infect mosquitoes which could then transmit the virus to men and horses.

Before incriminating an arthropod as a vector of any specific disease there are certain essential requirements which must be fulfilled. In the first place the suspected arthropod must be associated in *time* and *place* with the "*person*" of the infected donor and recipient hosts. In the case of biting arthropods this association implies that the suspected vector must bite such hosts. The necessity of applying this criterion may be seen from the following examples. *A. simpsoni* is a monkey to man vector of yellow fever in some parts of Uganda but in other areas where virus is present in monkeys and *A. simpsoni* is also found, there is little human yellow fever. The reason for this is apparently due to the fact that *A. simpsoni* in the latter areas fails to bite man (Gillett, 1951). Again while house flies have been found capable of excreting poliomyelitis and Coxsackie viruses, their failure to play any significant part in the epidemiology of these viruses may be due to the fact that they do not appear to be particularly associated with human faeces which are a source of virus (Francis, Brown and Penner, 1948).

Abstract (Continued)

The second criterion is that there must be evidence that virus infections are occurring in the hosts in nature, and the virus must be recovered in the field from the suspected vector.

The third criterion is that the vector should be able to transmit the virus to the host. Numerous arthropods may be infected with virus but remain incapable of transmission to a susceptible host. Such vectors may be referred to as dead-end vectors.

I should like to stress that, in accordance with the title of this paper I have applied the term "vector" to arthropods and the term "host" to vertebrates. This concept of a vector is correct where transmission is by simple mechanical means in which the arthropod is accidentally contaminated externally or internally with virus. It is also correct from the aspect of *disease* in both mechanical and biological transmission. However, from the point of view of the reservoir of those viruses which are biologically transmitted, the arthropod qualifies better as a host than does the vertebrate.

Since the discovery that fungi cause disease in animals and plants a great number of transmitting agents have been described. One animal mycosis is now considered to be predominantly insect-borne.

Insects appear praticularly well-suited for the transmission of fungal diseases. No fungi are known to parallel the virusus, protozoa and nematodes, by significantly multiplying within their vectors.

The fungal material carried by the insect generally consists of spores which vary enormously in size, shape and origin. The one dominant factor favouring the insect dispersal of a fungus, however, is the possession of "wet" spores which are produced in sticky masses.

But each species of mosquito is not genetically uniform, and Huff (1929) showed that it was possible to breed a line of *Culex pipiens* which after a few generations of selection was able to act as host in 91 per cent of cases to *P. cathemerium*, while another line bred for insuseptibility was reduced to infection rates of the order of 7 per cent.

Avian malaria has a wide range of mosquito hosts - e.g. *P. gallinaceum* can infect the following genera of mosquitoes: *Aedes*, *Armigeres*, *Culex*, *Mansonia*, *Theobaldia* and *Anopheles* and of course many species. Mammalian malaria is much more host specific, but varies considerably from species to species. Mosquitoes entirely unrelated geographically to the parasite often prove to be extremely efficient vectors, e.g. *P. cynomologi* of the East Indies grows easily in *A. maculipennis* of of Europe, *P. ovale* of the Phillipines in *A.quadrimaculatus* of the U.S.A.

Japanese workers definitely established the role of the snail as vector of schistomiasis. Human schistosomiasis is now known to be endemic in many tropical and subtropical countries, with India as a notable exception, and it has been estimated that perhaps some 200 million people may be infected.

Abstract (Continued)

The three chief schistosome species, S. japonicum, S. mansoni and S. haematobium is have identical life histories except that the moluscan vectors are distinct and that the site of the mature worms in the body of the definitive host is largely different. S. japonicum and S. mansoni occupy the mesenteric veins whilst S. haematobium is found to the greatest extent in the vesical plexus. The schistosomes are digenetic trematodes.

Descriptors (Continued)

Western equine encephalomyelitis
mites
mosquitoes
men
horses
arthropod
vector
host
vector
fungi
insects
fungal diseases
spores
transmission
Schistosoma haematobium
S. mansoni
S. japonicum
snail
trematodes

Disease/Solid Waste Abstracts

No. DSW- 333

Author

Title
Expert Committee on Environmental
Sanitation; Second Report

Reference
World Health Organization TRS 47

Doc. No.	**Contract No.**	**Date issued**
		June 1952

Abstract

The Director-General asked the committee to devote its attention, during the present session, to the specific problem of the education, training, and utilization of personnel for environmental sanitation.[1]

By the term "environmental sanitation" the committee means the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical, mental, or social well-being. In particular it refers to the control of:

(a) methods for the disposal of excreta, sewage, and community wastes to ensure that they are adequate and safe;

(b) water-supplies, to ensure that they are pure and wholesome;

(c) housing to ensure that it is of a character likely to

(i) provide as few opportunities as possible for the direct transmission of disease, especially respiratory infections, and

(ii) encourage healthful habits in the occupants;

(d) milk and other food-supplies, to ensure that they are safe (the question of their nutritive quality being excluded from consideration);

(e) personal and public habits of cleanliness, especially in relation to disease;

Descriptors

education
training
education of personnel

pg 2

Abstract (Continued)

(f) arthropod, rodent, mollusc, or other alternative hosts associated with human disease;

(g) atmospheric conditions, to ensure that the external atmosphere is free from deleterious elements and that the internal conditions of workshops, houses, etc., are suitable for the occupations undertaken in them;

(h) factories, workshops, dwellings, streets, and the general environment, to ensure freedom from risk to health whether mechanical, chemical, or biological, and to provide the best working and living conditions.

Reference:

1. In general, the definition given is based on that used in the report on the first session of the Expert Committee on Environmental Sanitation (World Health Organization, Rep. Ser. 1950, 10, 5).

Disease/Solid Waste Abstracts

No. DSW- 334

Author

Title

Expert Committee on Environmental

Sanitation - Third Report

Reference

World Health Organization Technical Report Series

Doc. No.	Contract No.	Date issued
No. 77		April 1964

Abstract

The following definitions were adopted for the purposes of this report:

(a) The term "environmental sanitation" means the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical, mental, or social well-being.

(b) The term "rural areas and small communities" refers to areas where agriculture is the chief or even the sole industry and where there is a lack of diversity of skill and of organized community services, or to areas where the dwellings are scattered or are in small groups, which dispersion creates difficulty in the provision of organized community services such as water-supply, excreta disposal, control of vectors of disease, and similar services, at a cost suited to the economic level of the persons concerned.

The committee notes that since sanitation problems differ so widely in different areas there is general belief that no common concepts and understandings are applicable. It feels there is need to promote an understanding of the basic similarity of sanitation needs in all areas and among all peoples. Sanitation is fundamental and basic to individual and community existence. It relates to the essentials of life and health, the environmental significance of air, water, food, and shelter, which last includes clothing, and, in some places, protection against insect vectors of disease. These basic environmental essentials are common to all peoples, and differences between areas are not differences in kind but only in complexity.

Descriptors

environmental sanitation
sanitation
rural areas
small communities
water-supplies
vectors
death rate
conductive
social development
soil sanitation
human excrement
garbage
manure
fly-breeding
rodent infestation
domestic animals
health education

Abstract (Continued)

Sanitation in Rural Areas and Small Communities

Relationship of sanitation to health

It is well established that there is a relationship between the provision of adequate environmental sanitation and the state of health of the population. It is shown by the example of the reduced incidence of those diseases which are commonly acquired or transmitted from excreta or conveyed to man by contaminated water-supplies, or transmitted by living vectors of disease.

Examination of the 1952 edition shows that the death-rate of the age-group 1-4 years in inadequately sanitated countries may be from 30 to 40 times as high as that in well-sanitated countries.

The general improvement of hygienic conditions promotes a state of well-being in the population which is conducive to its social development.

There is considerable evidence that the diminished incidence of excremental and water-borne diseases which results from improvements in environmental sanitation is accompanied by a marked decrease in morbidity from other diseases the etiology of which is not directly related to either excreta or contaminated water-supplies.

Present sanitary conditions in underdeveloped countries

The committee reached the following conclusions:

In many of these countries, more than 80% of the people live in rural areas and small communities.

A diversity of factors including political, racial, and religious differences within the population is not infrequently a serious obstacle to any form of organization of community health services.

At present, most of these people lack soil sanitation and practice indiscriminate fouling of the surroundings with human excrement.

Lack of adequate methods for disposal of garbage, manure, and other refuse leads to unlimited opportunities for fly-breeding and rodent infestation. Under these circumstances, domestic animals often feed on and spread human excreta, thus causing health hazards and economic loss.

Needs and Objectives

Basic sanitation needs for protection and improvement of health

The first step in any environmental programme should be the elimination of those factors which are the most important agents in the transmission of disease.

(a) Contaminated water-supplies;
(b) infections acquired by direct or indirect contact with human faeces;

Abstract (Continued)

(c) infections transmitted through the agency of arthropods, rodents, molluscs, or other vectors;
(d) contamination of milk and other food supplies;
(e) inadequate housing and overcrowding;
(f) diseases of animals communicable to man.

Technical and Administrative Aspects of Improvement

Health education of the public

Health education, adjusted to local conditions, is of the utmost importance in improving the health practices of a people.

Educational work should be done by persons who are thoroughly familiar with the sociology, habits, and customs of the people.

Every effort should be made so that children during their school life should have inculcated into them the proper appreciation of sanitary standards both by teaching in the classroms and by the day-to-day familiarity with good sanitary practice and habits through the provision of the best possible installations for their use.

Excreta disposal. Excreta disposal should be carried out so as to reduce to a minimum (a) the danger of direct contact with man; (b) the contamination of soil or of ground or surface water; (c) the possibility of transference to man through the agency of insects or animals; and (d) the possibility of creating a public or private nuisance.

The committee recognizes the widespread use, in many parts of the world, of human excreta as a fertilizer as well as the utilization of animal manure as a fuel. With the growing world population and the limited extent of world resources, all efforts to utilize sanitary by-products and return them to the soil should be encouraged. The necessity of controlling these activities in such ways as to reduce to an absolute minimum their inherent public-health hazards cannot be too strongly emphasized.

Refuse disposal. Community refuse, excluding excreta, may be disposed of in such a way as to conserve its value as a fuel or as a fertilizer, or it can be destroyed as quickly, completely, and innocuously as possible. In either case the process must be done in such a way as to prevent public nuisance, to avoid the breeding of flies and other insects, to discourage rodents, and to prevent the contamination of water, milk, and other food.

Vector control. In every area in which vector control is a primary need, suitable measures should be taken, but as an integral part of the general programme of environmental sanitation. It is emphasized that this activity should not take such precedence in the programme as to exclude action in the safe disposal of excreta and in the provision of safe water-supplies. Vector-control programmes should be based on a sound knowledge of the ecology of the vector under attack. The costs of such programmes must be carefully evaluated in terms of the overall health budget and their importance from the standpoint of health and well-being.

References:

1. Winslow, C.-E. A. (1951) The cost of sickness and the price of health, Geneva (World Health Organization: Monograph Series, No. 7).

Disease/Solid Waste
Abstracts

No. DSW-335

Author
R. R. Parker, Cornelius B. Philip, Gordon E. Davis, R. A. Cooley

Title
Ticks of the United States in Relation to Disease in Man

Reference
Journal of Economic Entomology

Doc. No.	Contract No.	Date issued
Vol. 30 p51		1937

Abstract

Five tick-borne diseases of man are now known to be endemic in the United States - Rocky Mountain spotted fever, tularaemia, relapsing fever, Colorado tick fever and tick paralysis. One or more of these diseases occur in each of 46 states (all but Connecticut and Vermont) and tick transmission has been proved in 37. The three sections of greatest incidence are the Rocky mountain region and adjacent areas, Texas, and an area near the mid-Atlantic coast, extending through Maryland, Virginia and North Carolina.

Five species of ticks have been incriminated in the transmission of these diseases, five others are considered as potential vectors, and three more are recognized as actual or possible indirect agents of infection because of their known or suspected roles in the natural maintenance of certain of the pathgens concerned.

The disease agents known to be carried by our native ticks belong to four diverse groups of pathogens - the rickettsiae, the bacteria, the filterable viruses and the spirochetes. On experimental evidence, the anaplasmas may be added.

Ticks not only transmit the infectious agents listed, but also function in their perpetuation in nature. The infectious diseases that ticks transmit to man are primarily diseases of the native fauna. Occurrence in the former is purely fortuitous, since man is neither a normal host of ticks nor of the disease agents that they transmit.

Descriptors

ticks
disease
Rocky Mountain spotted fever
Dermacentor andersoni
tick paralysis
tularaemia
Colorado tick fever
tick-borne relapsing fever
control
small mammalian hosts
large animal hosts
Dermacentor variabilis
American dog tick
eastern wood tick
eastern Rocky Mountain spotted fever tick
dogs
domestic animals
deer
rodents
man
Microtus
mice
Peromyscus
Dermacentor occidentalis
Pacific coast tick
Ornithodoros hermsi
chipmunks
tamarack squirrels

Descriptors (Continued)

Ornithodoros turicata
terrapin
spermophiles
cottontail rabbits
prairie dogs
prairie dog owls
jackrabbits
Amblyomma americanum
lone star tick
carnivores
Amblyomma cajennense
Ornithodoros parkeri
Ornithodoros talaje
Ixodes ricinus californicus
horses
cattle
cats
cougars
coyotes
brush rabbits
Douglas ground squirrels
lizards
Haemaphysalis leporis-palustris
showshoe hares
ruffed grouse
Rhypicephalus sanguineus
brown dog tick
Dermacentor parumapertus
tularemia
deer fly
relapsing fever
Boutonneuse Fever

Disease/Solid Waste
Abstracts

No. DSW-336

Author

C. E. Terry, M.D.

Title

Fly-borne Typhoid Fever and Its Control in Jacksonville

Reference

Public Health Reports

Doc. No.	Contract No.	Date issued
V. 28 p. 68-73		1913

Abstract

The source of the water supply of Jacksonville, as well as systematic bacteriological examination of this supply, have enabled us, we feel, to completely eliminate it as a factor in the spread of our typhoid fever.

Together with the elimination of the water supply as a possible carrier of our typhoid fever, I have been able, since January, 1910, to eliminate milk as a factor, with the exception of three cases during the spring of the present year. Since January, 1911, a case record has been kept of all the local conditions surrounding each case, such as milk and water supply, location as to privy or sewer district, recent contact with known cases, eating places, screening, etc.

There remained in my mind but two possibilities worthy of much consideration - contact cases and those due to fly carriage.

The conditions existing in the privy district at that time were such as to further in every way fly transmission of intestinal diseases. There were about 8,500 privies in the city which accommodated 40 per cent of our population.

These 8,500 privies were such as are commonly seen in rural districts, and I can truthfully say that not a single one made the slightest pretense of protection against flies. In many instances, where a number of houses were owned by the same landlord, to economize space and money one community privy would be found within 25 or 30 feet of from three to six kitchens. Each privy was a reeking mass of filth swarming with flies which abandoned it only when the odor of cooking attracted them through the near-by windows. Surely here were present the three essentials to fly carriage of intestinal diseases - exposed human exrement, unprotected food supplies,

Descriptors

water supply
bacteriological examination
typhoid fever
milk
privy
sewer district
eating places
Screening
contact cases
fly carriage
transmission
intest diseases
flies
excrement
food
deaths
sewerage
seasons

Abstract (Continued)

and an abundance of flies.

I regret that prior to 1910 scarcely any case reports were made to the health office, so that I can not determine the distribution of the disease before that period. In 1910 we had a considerable increase in the number of deaths over the preceding two years. I attribute this increase in part to more accurate data and to the fact that the city had grown so rapidly during this period that sewerage extension lagged far behind the requirements and each year the number of new privies constructed outnumbered the new sewer connections. Flies during this season reached their height about the end of the first week in July, while the same month furnished the high-water mark of the typhoid cases reported.

We succeeded, in August, 1910, in securing the passage of an ordinance requiring all privies to be rendered fly proof.

Beginning with January, 1911, the department has required that the sick room in every case of typhoid fever be screened and the flies destroyed by means of poison or sticky fly paper.

As a result, I believe, of the screening of the privies and sick rooms the number of cases of typhoid fever reported to the health department during 1911 was 158 against 329 for 1910, the deaths for the same yers being 40 against 62. There was actually a greater reduction in the number of cases, as the reports for 1911 were more complete than those of 1910. Not only did this reduction occur, but we found that the distribution of the cases as to privy or sewer districts was practically reversed in 1911 from that of 1910, showing no disproportion of cases in the privy districts. The 1911 cases were distributed according to the population, regardless of methods of sewage disposal.

It is interesting to note that of the 158 cases occurring in Jacksonville during 1911, 88 or 55 per cent, were imported, the large majority from the surrounding country districts, where the privy and "back lot" unite to solve the question of sewage disposal. During 1911 the enforcing of the privy ordinance was vigorously pushed and by January 1912, these places were in as nearly a sanitary condition as it is possible to keep them.

The most marked reduction in the typhoid case rate has taken place this year. At the present writing we have had only 87 cases reported with 16 deaths. Of these, 48 acquired their infection elsewhere and were brought here for treatment. In only 39 cases could the infection be charged to Jacksonville.

I am fully aware that the facts above stated do not furnish all the requirements of strictly scientific proof that our typhoid fever was for the most part fly borne, but it would appear that this was the case, as the only measures we have made use of to reduce our typhoid rate have been directed against this insect, and the only change in sanitary conditions throughout the city has been the fly proofing of the privies. I feel that we are justified in attributing the major portion of our cases, prior to the enforcement of the privy law, to the house fly.

**Disease/Solid Waste
Abstracts**

No. DSW-337

Author

R. W. Chamberlain, R. K. Sikes and W. D. Sudia

Title

Attempted Laboratory Infection of Bird Mites with the Virus of St. Louis Encephalitis

Reference

American Journal of Tropical Medicine and Hygiene

Doc. No.	Contract No.	Date issued
Vol. 6 p.1047		1957

Abstract

Mites which parasitize birds have been suspected of being reservoirs of St. Louis encephalitis (SLE), principally upon extensive studies by Smith and associates. These workers isolated SLE virus from common chicken mites, Dermanyssus gallinae, collected near St. Louis (1944), and later showed that this mite species could be infected in the laboratory and could pass virus through its eggs to subsequent generations (1945, 1946). After further investigation, they reported transmission of virus to chickens bitten by these mites and infection of normal mites (1947) and mosquitoes (1948) from the chickens. Field isolations of SLE and other encephalitis viruses from bird mites by other investigators tended to substantiate the results of Smith and coworkers, and gave rise to the theory that mites were also reservoirs of Eastern (EEE) and Western equine encephalitis (WEE).

In spite of this evidence, however, recent studies have cast doubt on the general importance of mites as reservoirs of these three viruses.

Experimental

Dermanyssus gallinae. Experiment 1. Approximately 7,000 mites, half of which were adults and half in immature stages, were given opportunity to feed upon two infected chicks over a 20-hour period.

No virus could be recovered from the mites beyond the day of the infected blood meal, nor was any isolated from the excrement of 350 adult female mites tested on the 6th day, or from 1,250 protonymphs produced by these females, tested 8 days after the infected meal. No virus was detected in the blood, brains, and hearts of 21 chicks which had been exposed 1 to 3 days each to the feeding of the entire "infected" mite colony.

Descriptors

mites
encephalitis - Eastern
- Western
- St. Louis
Culex tarsalis

birds
Dermanyssus gallinae
chickens
titers
Culex quinquefasciatus
Ornithonyssus bursa

reservoirs
virus
transmission
mosquitoes
Culexpipiens
O. sylvarum

Abstract (Continued)

In spite of the relatively high titers of the virus circulating in the blood of the chicks serving as the infection source, and of the large numbers of mites involved in the studies, no detectable infections were produced in the mites and no transmissions to chicks by their bites could be demonstrated. The concentrations of virus ingested were up to 1,000 times higher than adequate for 100 per cent infection of susceptible mosquitoes such as *Culex quinquefasciatus*, *C. pipiens* and *C. tarsalis*. Even allowing for the much smaller volume of blood ingested by the mites (0.1 to 0.01 that of a mosquito), these virus concentrations should have been adequate for infecting the mites if they were of the same degree of susceptibility as the mosquitoes.

Summary

Laboratory studies were conducted in attempts to infect three common species of bird mites, *Dermanyssus gallinae*, *Ornithonyssus bursa* and *O. sylvarum*, with the virus of St. Louis encephalitis and to transmit infection by the bite of these mites to newly hatched chickens. The virus tests were performed in three-week-old white Swiss mice, inoculated intracerebrally. Detectable virus persisted less than 2 days in the mites, and no transmissions by bite were shown. These negative results support those previously reported by Reeves *et al*. (1955) and indicate a lack of importance of bird mites in transmission of active St. Louis encephalitis infection.

Disease/Solid Waste
Abstracts

No. DSW-338

Author
Cluff E. Hopla

Title
Experimental Transmission of Tularemia
by the Tropical Rat Mite

Reference
American Journal of Tropical Medicine

Doc. No.	Contract No.	Date issued
V. 31 p768		1951

Abstract

Summary

1. Quantitative methods of study were used in an attempt to observe the changes which took place within infected mites (Bdellonyssus bacoti) after prolonged periods of starvation and after feeding on various types of hosts.

2. The tropical rat mite was shown capable of retaining an infection of Bact. tularense from the protonymph stage throughout the subsequent stages of a single generation. In certain instances this mite transmitted the infection to the next generation.

3. The infection was also retained after several feedings on recovered mice without reduction of the number of infectious organisms.

4. Even after prolonged periods of fasting, no significant decrease in the number of organisms per mite was noted.

5. The tropical rat mite was unable to produce an infection in normal mice by biting. Infection resulted when the mites were crushed orally by the mice.

6. The LD titration indicated no loss of virulence in the Sm strain of Bacterium tularense upon mite passage, nor was any increase in virulence noted.

Descriptors

tularemia
white mouse
mites
water rats
rodents
vectors
tropical rat mite
Bdellonyssus bacoti (Hirst, 1913)

Disease/Solid Waste
Abstracts

No. DSW-339

Author

James Gear

Title

The Rickettsial Diseases of Southern Africa

Reference

South African J. Clin. Sc.

Doc. No.	**Contract No.**	**Date issued**
5 - 3 p158		Sept. 1954

Abstract

As epidemic typhus recedes in importance, murine typhus looms larger.

In Johannesburg a survey of rats before the War failed to reveal the presence of murine typhus fever. The first isolation from rats was made during the War. Since then the rickettsiae have been isolated regularly from rats. It seems then that the infection was introduced recently, but having been introduced it has persisted, and every now and then a human case occurs in Johannesburg from an infection contracted usually in the neighborhood of the market or main railway centres, where the infection of the rats is heaviest.

The veld rodents so far tested have given negative results and appear to play no part in maintaining infection. The main reservoir of murine typhus is the house rat, Rattus rattus, and the most important vector is Xenopsylla cheopis, though other species of fleas have also been incriminated as harbouring the infection. The disease is spreading.

Tick-bite fever, the variety of tick typhus occurring in Southern Africa, is caused by **Rickettsia** or Dermacentroxemes conori var. pijperi, transmitted by ixodid ticks. and is widespread in Southern Africa, but is especially common in the bushveld areas of the Transvaal and along the coastal belt of Mozambique, Natal and the Eastern Province.

It seems probable that most species of ixodid ticks are capable of transmitting the disease.

The causative rickettsiae in a recent systematic survey were isolated from the 5 following species: Amblyomma hebraeum, Rhipicephulus appendiculatus, R. evertsi,

Descriptors

Rickettsial diseases
epidemic louse-borne typhus fever
Rickettsia prowazeke
human louse Pediculus humanus
Murine flea-borne typhus fever
Rickettsia mooseri
rat fleas
Xenopsylla cheopis
Tick-bite fever
tick typhus
Rickettsia conori var pijperi
Q fever

Abstract (Continued)

Haemaphysalis leachi, *Hyalomma aegypticum*.

It has also been shown that all stages of the common dog tick *Haemaphysalis leachi* - larva, nymph and adult - are infective and there is hereditary transmission of the rickettsiae through the egg to the succeeding generations. Apparently this hereditary transmission may continue indefinitely. No mammalian reservoir is therefore necessary for preserving the infection in nature.

Most rats caught in the Northern Suburbs of Johannesburg gave negative complement-fixation reactions with *R. mooseri*. A number, however, gave positive reactions with *R. conori var. pijperi*. These findings suggested that these rats had had tick-bite fever or had been infected with a serologically-related organism from the brain of a rat, *Rattus rattus*, a strain of rickettsiae was isolated. The strain resembled tick-bite fever, and proved to be different from murine typhus and rickettsial pox. Thus it was proved that rats may harbour the rickettsiae of tick-bite fever. It was considered that they, like man, were infected by ticks accidentally picked up on the veld. It seemed likely that veld rodents were more intimately concerned in the ecology of this rickettsial disease.

Arrangements were then made to collect various veld rodents in this neighbourhood. A considerable proportion of the striped mice, *Rhabdomys pumilio* and the vlei rats, *Otomys irroratus* gave positive reactions with *R. conori*, indicating past infection with this rickettsia.

Rickettsial pox is caused by *Rickettsia akari*, a rickettsia which in many respects resembles the rickettsiae of the tick-typhus or Rocky Mountain-spotted-fever group. It appears that the principal vector to man is a mite, *Allodermanyssus sanguineus*, which often parasitizes the house mouse, *Mus musculus*. Strains of this rickettsia have also been isolated from mice trapped in houses where cases of rickettsial pox have occurred. The house mouse therefore may be concerned in the ecology of this disease as the house rat is concerned in murine typhus.

On testing sera from guinea-pigs recovered from tick-bite fever and rickettsial pox respectively, it was found that the 2 diseases could be differentiated from each other.

Sera from human cases suspected to be cases suffering from tick-bite fever are routinely tested in convalescence for antibodies to both *R. conori var. pijperi* and *R. akari* .

In some cases the reaction has been with *R. akari* only. One of these cases gave a history of a previous attack of tick-bite fever about 3 years before the illness resembling rickettsial pox.

There is thus serological evidence of the occurrence of rickettsial pox in this country. Most of the cases clinically resembling rickettsial pox that have been seen in this country have contracted their infection whilst in the bushveld, and it is likely that the reservoir of the infection will be found to be one of the wild rodents and not the house mouse. Similarly the vector may be some other mite than *Allodermanyssus sanguineus*.

Another rickettsial disease in Southern Africa is Q fever. This disease was first recognized in Queensland. It was caused by a rickettsia named *R. Burneti* found to

Abstract (Continued)

be identical with R. diaporica isolated from naturally-infected ticks in Montana.

It became apparent that Q Fever was not confined to Queensland and Montana, but was an important and widespread disease in many parts of the world, causing a condition resembling virus pneumonia. This disease is so prevalent in this country that most adult South Africans are immune. This immunity is not shared by immigrants from North-West Europe, and many have suffered from Q fever soon after their arrival in this country.

As the separation of the urban from the rural population in this country is becoming more distinct an increase in the incidence of Q fever in the adult population of South Africa can be expected.

Although R. burneti is a parasite of various species of ticks the infection is apparently not often transmitted by tick bite. Most patients contract the disease in rural areas by association with cattle, presumably by inhalation of infected dust or by drinking infected milk.

Disease/Solid Waste
Abstracts

No. DSW-340

Author

A. W. Bacot and C. J. Martin

Title

Observations on the Mechanism of the Transmission of Plague by Fleas

Reference

Journal of Hygiene 13 (Plague Supp. 3)

Doc. No.	Contract No.	Date issued
423-39 + 3 plates		1914

Abstract

The literature on the transmission of plague by fleas was reviewed in 1905 in the first series of Reports on Plague Investigation in India (Journal of Hygiene, Vol. VI. p. 422), and it is only necessary to epitomise briefly the main facts here.

Our results may be briefly summarised as follows:

Under conditions precluding the possibility of infection by dejecta it was found that two species of rat-fleas, Xenopsylla cheopis and Ceratophyllus fasciatus, fed upon septicaemic blood, can transmit plague during the act of sucking, and that certain individuals suffering from a temporary obstruction at the entrance to the stomach were responsible for most of the infections obtained, and probably for all.

Descriptors

Review
transmission
plague
fleas

Disease/Solid Waste
Abstracts

No. DSW-341

Author

Winston H. Price

Title

The Epidemiology of Rocky Mountain

Spotted Fever

Reference

American Journal of Hygiene (Lancaster, Pa.)

Doc. No.	Contract No.	Date issued
V. 60:292-319		1954

Abstract

Dogs and field mice (Microtus pennsylvanicus) appear to be important vertebrates involved in the transmission chain of Rickettsia rickettsii in Maryland.

The virulence of R. rickettsii isolated from D. variabilis is consistently increased by 1 to 3 chick embryo passages and by one passage in human beings in the localities studied.

Tick-to-tick transmission has been shown to occur in Microtus pennsylvanicus when larvae and nymphs of D. variabilis were used, and in dogs when the adult stage was used.

The cottontail rabbit does not appear to play an important role in maintaining R. rickettsii in Maryland insofar as those strains that are involved in the human infection are concerned.

Multiplication in natural animal hosts tends to lower the virulence of R. rickettsii, while passage in the arthropod vector appears to increase the virulence of R. rickettsii, presumably through selection or a combination of mutation and selection.

Under optimal conditions, 76 per cent of the uninfected larvae and 81 per cent of the uninfected D. variabilis nymphs were infected when permitted to feed on infected Microtus pennsylvanicus; 82 per cent of the uninfected adult D. variabilis became infected when fed on infected dogs.

The low virulent strains appear to die out after 14 to 16 months in adult infected D. variabilis under conditions that would approximate those existing in nature.

There is 100 per cent transmission of the rickettsiae from the egg to the larval, nymphal and adult stages.

Descriptors

Epidemiology
Rocky Mountain spotted fever
Rickettsia Rickettsii
wood tick
Dermacentor andersoni
dogs
field mice (Microtus pennsylvanicus)

Abstract (Continued)

In Maryland, it would appear that, while transovarial transmission does play a role in maintaining R. rickettsii in the field, to maintain the disease in nature infected ticks must infect uninfected ticks by feeding on animals. This dual survival mechanism would thus be similar to that described by Ricketts in his brilliant studies on R. rickettsii in the Bitter Root Valley.

Disease/Solid Waste Abstracts

No. **DSW-** 342

Author

E. S. Anderson, N S. Galbraith, C.E.D. Taylor

Title

An Outbreak of Human Infection due to Salmonella Typhimurium Phage-Type 20a Associated with Infection in Calves

Reference

Lancet p 854

Doc. No.	**Contract No.**	**Date issued**
		1961

Abstract

Between July and October, 1958, 55 separate food-poisoning incidents, comprising 90 cases due to Salmonella typhimurium phage-type 20a, were reported in South-East England. There was 1 death. Investigations were directed to calf meat, after the isolation of the same organism from an outbreak of enteritis in calves. Though not conclusive, the evidence strongly suggested calf meat as the vehicle of infection in at least three-fifths of the incidents. Examinations at the abattoirs concerned showed that up to 12.7% of rectal swabs of apparently healthy calves yielded S. typhimurium phage-type 20a, and the same organism was isolated from 9.5% of specimens of calves' palates from one butcher's shop.

The investigation demonstrates the value of phage-typing in the study of the epidemiology of S. typhimurium infections.

Descriptors

food poisoning
calves
butcher shop
Salmonella typhimurium
meat (calf)
epidemiology
enteritis
abattoirs
phage-typing

Disease/Solid Waste Abstracts

No. DSW- 343

Author

Clark W. Heath, Jr., M.D., Aaron D. Alexander, Ph.D., and Mildred M. Galton, Sc.M.

Title

Leptospirosis in the United States

Reference

New England Journal of Medicine

Doc. No.	Contract No.	Date issued
273(16):857-64		1965

Abstract

Analysis of 483 Cases in Man, 1949-1961.

Between 1949 and 1961 the laboratory diagnosis of 483 cases of leptospirosis in the continental United States had been confirmed primarily through the reference laboratory services of the Walter Reed Army Institute of Research, Washington, D.C., and the Communicable Disease Center, Atlanta, Georgia. Data concerning the laboratory, epidemiologic and clinical aspects of these cases are presented in this report.

It was apparent to Molner et al. and to previous workers that the number of cases of leptospirosis being reported in this country was disproportionately low when compared with the incidence in Western Europe. The prevalence of leptospirosis in American rats and the populations exposed to risks of infection were comparable to those in Europe.

Understanding of the epidemiology of leptospirosis had broadened considerably by 1948. Populations at risk to infection were no longer considered limited to occupational groups in contact with rats. Leptospirosis was shown in many countries to occur widely in dogs, cattle and swine, and sporadic cases and outbreaks of disease in man were related epidemiologically to reservoirs of leptospirosis in domestic animals. Infections in domestic animals were related not only to types previously recognized (such as icterohaemorrhagiae in dogs, cattle and swine and grippotyphosa and pomona in cattle and swine) but also to new types (such as canicola in dogs).

Descriptors

Leptospirosis
rats
dogs
cattle
swine
livestock
urine
wild mammals
rodentia
opossums
skunks
raccoons
foxes
occupations
construction work
veterinary work
swimming-pool lifeguard
mortician
physician
goat
unskilled labor
abattoir work
policeman
coal miner
railroad conductor
taxi driver

Abstract (Continued)

The demonstration of serotype *pomona* infections in livestock alerted clinicians to the hazard of leptospiral infection among persons having contact either with livestock or with fresh water (that is, ponds and streams) contaminated by livestock urine. The epidemic potential of leptospirosis in the United States was apparent when Schaeffer presented 50 cases of *pomona* infection among a group of 80 young people swimming in a creek located in a pasture for cattle and swine.

During the past ten years, there has been a remarkable expansion of knowledge of the distribution of leptospirosis in mammalian hosts. It is now known that infections occur in a large proportion of wild mammals of various families in addition to rodentia. For many species such as opossums, skunks, raccoons and foxes, the finding of infectivity ratios in the order of 10 to 50 per cent is not uncommon. In addition to the types commonly associated with rodents and domestic animals, a considerable number of heretofore unrecognized types have been disclosed in various wildlife surveys. Many of the types (such as *pomona* and *icterohaemorrhagiae*) previously associated with one or two mammalian species have now been found, frequently in high prevalence, in a wide variety of other mammals. Interspecies spread has been recognized increasingly among domestic animals.

A wide range of occupations was represented in this case series. The most commonly encountered category was that of unskilled labor, which consisted generally of various forms of construction work (65 cases, or 17 per cent). In 104 cases (27 per cent) the occupation entailed direct contact with potentially infected animals, in either farming or abattoir work or veterinary work. In the majority of cases, however, the patient's occupation was largely incidental to the source of his infection. Miscellaneous occupations included such divergent categories as policeman, swimming-pool lifeguard, coal miner, mortician, railroad conductor, physician and taxi driver.

Source of infection. The place of infection could be ascertained with reasonable certainty in 310 cases, 191 (62 per cent) of which could be attributed to a specific infecting source. A considerable proportion of cases were acquired about the home (76 cases or 25 per cent) or on farms (63 cases, or 20 per cent). Fifty-nine cases (19 per cent) involved immersion, largely the patients' swimming in stagnant water. Thirty-five patients (11 per cent) were exposed in abattoirs.

Of the 191 cases in which a probable infecting source could be ascertained 60 (31 per cent) involved contact with rats, 57 (30 per cent) with dogs, 40 (21 per cent) with cattle, and 24 (13 per cent) with swine. When cases of contact with cattle and swine are combined the rate (34 per cent) exceeded that of both rats and dogs as the probable source. Three cases involved cortact with raccoons, 2 while the patient was hunting; 1 case related to a goat. Seven infections resulted from contact with leptospires in the laboratory. For some cases the diagnosis of leptorpiral infection was confirmed in the animal contact, or illness was observed in the animal. In many, however, identification of the probable animal source was presumptive.

Disease/Solid Waste
Abstracts

No. DSW-344

Author

James W. Mosley, M.D.

Title

Water-Borne Infectious Hepatitis

Reference

Medical Progress

Doc. No.	Contract No.	Date issued
Vol. 261 No. 14		1959

Abstract

Since the nineteenth century there have been epidemics of jaundice that have been attributed to water-borne transmission. The evidence accumulated in recent years is sufficiently complete to warrant recognition of this mode of spread of infectious hepatitis as an epidemiologic entity. In this regard, infectious hepatitis is the first viral disease for which a water-borne route of infection has been generally accepted. Such a route has been postulated for poliomyelitis, but no studies have been reported in which conclusive evidence was obtained.

It is believed that person-to-person contact is the most frequent type of transmission of infectious hepatitis, and there is no evidence to the contrary at the present time.

Discussion

The evidence presented in some of the reports is not convincing that the epidemic considered was in fact due to transmission by drinking water. Many investigators were unable or failed to define the population actually exposed to the suspected source, or to exclude other possible common sources. In most reports, the evidence is sufficiently complete for the postulate to be accepted as the most likely to explain the eipdemiologic findings. The total evidence that water-borne transmission occurs seems entirely adequate.

Considering the facts that the virus of infectious hepatitis is excreted in the feces, probably for several weeks in a typical case, that it is probably one of the most hardy micro-organisms and that a large number of opportunities for contamination of water by feces must occur every year, as evidence by the number of epidemics of gastroenteritis, diarrhea and dysentery due to pathogenic enteric bacteria, it is

Descriptors

jaundice	water-borne transmission	hepatitis, infectious
infectious	contact	feces

Abstract (Continued)

remarkable that there have not been far more water-borne epidemics of infectious hepatitis. The only explanation that offers itself readily is that the chance combination of contamination of a water supply and a person contributing to the contamination who is excreting the virus is rare. This seems inadequate, however, since the virus and also the opportunities for contamination are so prevalent. It emphasizes the fact that the ecologic behavior of the agent cannot be delineated on the basis of present information.

References:

1. Kling, C. Considerations sur l'èpidèmiologie de la poliomyèlite. Bull. Office Inernat. d'hyg. pub. 23:1228-1233, 1931.

2. Gear, J. H. S. Extrahuman sources of poliomyelitis. In International Poliomyelitis Congress. Poliomyelitis: Papers and discussions presented at the Second International Poliomyelitis Conference, compiled and edited for International Poliomyelitis Congress. 555 pp. Philadelphia: Lippincott, 1952. P;. 343-354.

3. United States Senate, 80th Congress. Data Compiled by the Public Health Service: Hearings before a Subcommittee of the Committee on Public Works: 1st Session on S. 418. Washington D. C.: Government Printing Office, 1947.

4. Neefe, J. R. Stokes, J., Jr., Baty, J. B., and Reinhold, J. G., Disinfection of water containing causative agent of infectious (epidemic) hepatitis. J.A.M.A. 128:1076-1080, 1945.

5. Idem. Inactivation of virus of infectious hepatitis in drinking water. Am. J. Pub. Health 37:365-372, 1947.

Disease/Solid Waste Abstracts

No. DSW-345

Author

Gordon K. Sweatman

Title

Distribution and Incidence of Echinococcus Granulosus in Man and Other Animals with Special Reference to Canada

Reference

Canadian Journal Public Health

Doc. No.		Contract No.	Date issued
Vol. 43	p480		1952

Abstract

It is evident that human cases have occurred in localities close to moose and wolf populations. Most of these were diagnosed as a result of chest x-ray services, but since this parasite has been recorded more frequently in the liver of man than in the lungs, it is probable that many cases have been overlooked. It is conceivable that the human infections were acquired as a result of handling infected wolves, but more probably from contact with dogs that had eaten infected carcasses of moose or more rarely some other wild herbivore.

Dogs found in the vicinity of hunting lodges are in danger of becoming infected. If transported to farming districts in southern Canada these animals could act as a source of infection for both humans and farm animals. Precautions should be taken to prevent an increase of hydatid disease in Canada that may result from increased contacts between man, dogs and infected wild animals.

References:

1. Rausch, R., and Schiller, E. L.: Hydatid Disease (Echinococcosis) in Alaska and the Importance of Rodent Intermediate Hosts. Science. 1951, 113:57.
2. Riley, W. A.: Reservoirs of Echinococcus in Minnesota. Minn. Med., 1933, 16:744. Maintenance of Echinococcus in the United States. J. Amer. Med. A., 1939, 48:170.
3. Schiller, E. L., and Rausch, R.: A Vole (Microtus), an Important Natural Intermediate Host of Echinococcus granulosus. J. Parasitol., 1950, 36 Suppl.: 30.

Descriptors

Hydatid disease
Echonococcus granulosus
tapeworm
wolves, Canis lupus
coyote, C. latrans
fisher, Martes pennanti
red foxes, Vulpes fulva
cougar, Felis concolor
arctic foxes, Alopex lagopus
dogs
moose, Alces americana
white-tailed deer, Odocoileus virginianus
coast deer, O. hemionus columbianus
caribou, Rangifer arcticus
wapiti, Cervus canadensis
bison, Bison bison
reindeer, R. Tarandus
tundra voles, Microtus oeconomus
lemmings, Lemmus trimucronatus
red-baked mice, Clethrionomys gapperi
cat
swine
horse
man

Disease/Solid Waste Abstracts

No. DSW- 346

Author
Joseph E. Alicata

Title
Notes and Observations on Murine Angiostrongylosis and Eosinophilic Meningocephalitis in Micronesia

Reference
Canadian Journal of Zoology

Doc. No.	Contract No.	Date issued
43(5):667-672		1965

Abstract

In recent years, with the recognition of the rat lungworm, Angiostrongylus cantonensis, as one of the causative agents of eosinophilic menigoencephalitis, numerous studies have been carried out to determine its geographical distribution and the source of human infection. Thus far, the parasite has been reported among rodents or man from many islands of the Pacific (7), Australia (17), and the continent of Asia, including China (11), Malaya (21), Thailand (19, 20), and Viet Nam (14). In Micronesia, the parasite has been reported from rats in Guam (16), Majuro, Moen, Pingelap, and Ponape (13). Since the above observations were carried out before the public health importance of the rat lungworm was recognized, the writer, in January, 1964, and in January-February, 1965, made a trip to some of the islands of Micronesia, including Guam, Ponape, Rota, Saipan, and Tinian, to further ascertain the distribution of the parasite among rodents and to determine the possible source of human infection. Previous to that time, it had been indicated elsewhere that human infection resulted from willful or accidental ingestion of mollusks (1, 2, 12, 20), which serve as intermediate hosts of the parasite, or the habitual ingestion of raw freshwater prawns (6), which serve as carrier hosts.

In connection with the possible source of human infection among Ponapeans, some consideration should be given to their method of eating improperly cooked pork, especially during native feasts. Pigs on the island are customarily allowd to run loose and freely. Under such conditions, there is much opportunity for them to ingest terrestrial slugs and small snails, in the process of rooting. It has been experimentally demonstrated that pigs may harbor infective larvae of A. cantonensis in the visceral organs for at least 2 weeks after infection (4).

Descriptors

Murine angiostrongylosis
rat lungworm
Angiostrongylus cantonensis
eosinophilic meningoencephalitis
black rat
Rattus rattus
Norway rat
R. norvegicus
Polynesian rat
R. exulans
prawns
crags
hosts

Abstract (Continued)

In addition to characteristic morphological characters (3), the identity of the larvae was ascertained by finding the developing young adult parasites in the brain of white rats 16 days after the live larvae had been fed to the rats.

Present studies have indicated that the rat lungworm is present on the Micronesian islands of Saipan, Rota, and Tinian. Previously, the parasite had also been reported from Guam, Ponape, and Moen.

The average indicence of A. cantonensis among all the rats examined in the Micronesian islands has been found to be 32.8%. This comparatively low incidence is probably due to the fact that the predominant rat in Micronesia is the black rat, Rattus rattus. This confirms reports of previous surveys (2, 7) that indicated that the incidence of infection among the black rat is usually considerably less than among the Norway rat, R. Norvegicus, or the Polynesian rat, R. exulans.

In Micronesia, infective larvae of A. cantonensis have been found in various species of terrestrial mollusks, which serve as intermediate hosts of the parasite, as well as in freshwater prawns, coconut crabs, and land crabs, which serve as carrier hosts. It is likely that some of the cases of human infection in Micronesia result from the eating of these raw crustaceans.

References:

1. Alicata, J. E. 1964. Pigs and calves as carrier hosts for the infective larvae of Angiostrongylus cantonensis. J. Parasitol. 50(3, Sect. 2), 39.

2. Alicata, J. E. and Brown, R. W. 1962. Observations on the method of human infection with Angiostrongylus cantonensis in Tahiti. Can. J. Zool. 40, 755-760.

3. Mackerras, M. J. and Sandars, D. F. 1955. The life history of the rat lungworm, Angiostrongylus cantonensis (Chen) (Nematoda: Metastrongylidae). Austrailian J. Zool. 3, 1-25.

Disease/Solid Waste
Abstracts

No. DSW-347

Author
Hans Weill, M.D., Morton M Ziskind, M.D.,
Richard C. Dickerson, and Vincent J. Derbes, M.

Title

Allergic Air Pollutants in New Orleans

Reference

Journal of Air Pollution Control Assoc.

Doc. No.	Contract No.	Date issued
15(10):467-471		1965

Abstract

Outbreaks of bronchial asthma, defined by sharp peaks above the average number of emergency room visits at Charity Hospital in New Orleans, have been noted in this city since the early 1950's. These outbreaks have occurred during the summer and fall, with the months of October and November containing the most frequent and severest episodes. Early work on this problem associated emissions from spontaneous underground burning in abandoned city dumps with the high incidence and extracts for skin testing prepared from the emissions produced a significant number of positive skin tests in persons involved in the asthma outbreaks. Recent investigation showed that other sources of allergenic air pollution in the city were related to the epidemics of asthma. Attention has been focused on a large public grain elevator at the Mississippi River in the southwestern portion of the city. Grain extracts have produced high percentages of positive responses in susceptible patients with low response rate found in control subjects. Persons known to have participated in these outbreaks have been characterized as being allergic; a low incidence of patients with chronic bronchitis and emphysema has been found in this group. New meteorological data regarding the outbreak periods has been collected.

In contrast to the allergenic air pollution which appears to play an etiologic role in the recurring acute and chronic obstructive respiratory disease in New Orleans, Minneapolis, and Saskatchewan is the chronic bronchitis syndrome which occurs in certain service personnel and their dependents residing in the Tokyo-Yokohama area. Initially called Tokyo-Yokohama asthma, the nocturnal cough, shortness of breath and wheezing, unremitting in type, which was characteristically seen in heavy cigarette smokers, prompted recent workers in that area to rename this syndrome Tokyo-Yokohama

Descriptors

bronchial asthma
skin tests
respiratory disease
burning
grain elevator
emphysema
dumps
allergy
smoking

Abstract (Continued)

respiratory disease. These patients are, in general, nonallergic and very few had a prior history of asthma. Follow-up studies have shown a significant incidence of ventilatory impairment and many of these patients seem to fall within the chronic bronchitis-emphysema group of disorders. Although the role of sentization has not been completely excluded, it is likely that bronchial irritation in this area of heavy industrial atmospheric pollution is of major importance.

The patients involved in these outbreaks have strong allergic histories, tend to be nonsmokers with little evidence of chronic bronchitis or pulmonary emphysema and have the expected obstructive ventilatory imapirment. Similarities between grain asthma in Minnesota and Saskatchewan and asthma in New Orleans have been noted. An example of air pollution nonallergic bronchitis in the Tokyo-Yokohama area has been cited.

I

Disease/Solid Waste Abstracts

No. DSW-348

Author

Dean H. Ecke, Vector Control Specialist

Title

A Comparison of Fly Larval Production from Six Refuse Container Systems

Reference

American Public Works Association Yearbook

Doc. No.	**Contract No.**	**Date issued**
		1965

Abstract

Public health workers are painfully aware that backyard garbage containers are, all too often, the chief source of flies in urban communities. This is true over much of the United States and particularly in California.

Adult blow flies (Phaenicia) are readily attracted to fresh garbage on which they lay their eggs. Once-a-week garbage service does little to prevent severe fly problems. The garbage goes to the refuse disposal area but the fly pupae remain behind to emerge and create nuisances and possible health hazards in the neighborhood.

Two basic control practices have been widely applied in attempts to solve urban garbage fly problems. Neither approach has met with fully satisfactory results. First, much effort has been made to educate the public concerning proper garbage handling practices. This line of attack just doesn't work! It's virtually impossible to get the cooperation of enough people in an average neighborhood to maintain good fly control.

The second approach has been to increase garbage collection to a frequency which would effectively interrupt the fly life cycle. Fly larvae can escape from extremely tight containers even where adult flies are unable to enter.

The types of containers now used by householders for the storage of residential organic waste, or garbage are not capable of controlling the development of a residential fly problem. Much of the weakness is due to the human element.

The garbage grinder has been much maligned by engineers who build sewer systems and operators of water pollution plants. Public Health people have nothing but high praise for them as this method of organic waste disposal puts the materials

Descriptors

garbage
garbage grinders
Phaemicia
education
sacks
garbage storage
flies
refuse
larvae (fly)
garbage containers
blow flies
disposal area
food containers

Abstract (Continued)

out of the reach of the fly for all time. However, good storage is still needed for the unwashed food container. The garbage grinder will do the most to reduce the residential fly problem caused by inadequate storage. In lieu of this, good storage practices are a must, supplemented by increased frequency of collection if climatic and temperature conditions warrant. Liner sacks permitted fly larval migration to an extent almost equal to regular cans.

Disease/Solid Waste
Abstracts

No. DSW-349

Author

E. E. Wedman, D.V.M., M.P.H., Ph.D.

Title

Epidemiology - A Prerequisite to the Eradication of Animal Diseases

Reference

Journal American Veterinary Med. Assoc.

Doc. No.	Contract No.	Date issued
147(12):1550-5		1965

Abstract

One of the fundamentals in analysis of a disease condition, taking into consideration the total biological phenomenon, is known as epidemiology. It relies on various other disciplines to establish its facts. Biostatistics, ecology, microbiology, parasitology, entomology, sociology, meteorology, and demography are utilized as assisting disciplines.

Epidemiologic methods of study can be considered in 4 classifications: descriptive, formulation of hypotheses, analytical, and experimental.

Descriptive refers to collection of population data and its use to describe the frequency and distribution of disease in that population, and also the comparison of the distribution and frequency of disease in different populations and in different portions of the same population.

Forumulation of hypotheses refers to formulation of tentative theories that identify causal association and explain the frequency and distribution of the disease recorded in the descriptive study.

Analytical refers to testing of observations gained in the descriptive phase and any new observations.

Experimental refers to testing of hypotheses with controlled animal populations and environments.

Epidemiology is a method of research. Its purpose and aim are to break a disease problem into its various components and resynthesize these components into an over-all explanation of the phenomenon.

Descriptors

disease
distribution
ecology
entomology
dermography
reservoir
host
infections (inapparent)

epidemiologic methods
frequency
microbiology
sociology
hypotheses
transmission (of disease)
vehicle
carriers

population data
biostatistics
parasitology
meterology
etrologic agent
portal of entry
vector
cases

Abstract (Continued)

Infectious conditions involve 6 factors which are necessary for development of the infectious process. If any one is missing, the infectious process will not occur. Each infectious process must have:

An etiologic agent that possesses attributes that enable it to infect a susceptible host.

A source of reservoir of infection (for repopulation of the agent).

A mode of escape for the agent from the reservoir.

A mode of transmission or transfer of the agent from the reservoir to the host.

A portal of entry for the agent into the new host.

A susceptible host.

The epidemiologic method is concerned with populations Environmental, biological, social, and economic factors, which may conceivably influence the transmission of the agent from the reservoir host to other potential hosts, have to be considered. Therefore, epidemiology is concerned with multiple causation or with all of the factors acting together to perpetuate transmission and cause disease. It is concerned with the why, when and where of a disease more than the what.

Once the specific host-agent-environmental relationship is established, then the weak link in the chain of transmission of agent from an infected host to a potential host can be defined.

Most agent-host-environmental relationships are complex. The effectiveness of the etiologic agent to cause disease in the host is dependent upon many factors. All the factors of environment are relative, interrelated, and affect the agent, the transmitting vehicle or vector, and the host.

Transmission is linked primarily to infection and only secondarily to disease. The four levels of infections and their order of importance in the transmission of infectious agents are: inapparent infections, transitory carriers, clinical cases, and abortive cases.

Inapparent Infection. - This level of infection provides the greatest opportunity for transmission. In many diseases the greater proportion of the population has inapparent infections.

Transient Carriers. - This situation represents a state wherein the animal intermittently sheds the infectious agent.

Clinically Sick Animals. - These animals are usually less important than those with inapparent infections.

Abortive Cases. - Their period of infectiousness is usually short, but some may revert to a chronic and transient carrier state.

Reference:

Meyer, K. F.: Advances in Veterinary Science, Vol. 1. Academic Press, Inc., New York, N.Y. (1953): 1-48.

Disease/Solid Waste Abstracts

No. DSW-350

Author

Title

Diseases of Animal Origin or Common to Man and Animals in the United States

Reference

U.S. Department of Health, Education and Welfare, Public Health Service,

Doc. No.	Contract No.	Date issued
Communicable Disease Center Atlanta, Georgia		Aug. 1963

Abstract

I. Diseases and Infections transmitted from Animals to Man

II. Diseases and Infections Common to Man and Animals

III. Diseases Man May Acquire from Domestic Animals

IV. Diseases Man May Acquire from Wild Animals

V. Diseases Man May Acquire from Wild Animals via Arthropod Vectors

VI. Diseases which May be Transmitted via Animal Bites

This pamphlet lists individual diseases with their causative agents and provides a single sentence comment, usually on transmission or reservoir, in regard to each.

Descriptors

zoonoses
wild animals
vectors
animals
domestic animals
animal bites
man
arthropods

Disease/Solid Waste Abstracts

No. DSW-351

Author

Title

Reported Cases of Vector-Borne Diseases

1960 - 1964

Reference

U.S. Dept. of Health, Education, and Welfare

Doc. No.	Contract No.	Date issued

Communicable Disease Center, Training Branch,
Vector-Borne Disease Section, Atlanta, Georgia

Abstract

This report gives reported cases of vector-borne diseases in the United States in the period 1960 - 1964 and covers anthrax (54), encephalitis (12,724), malaria (464), murine typhus (213), plague (6), salmonellosis (61,675), spotted fever (1,108) tularemia (1,752), typhoid fever (3,376). It lists separately for 1964 the following incidence:

anthrax - 5
encephalitis - 3,231
malaria - 102
murine typhus - 29
salmonellosis - 21,113
spotted fever - 229
tularemia -343
typhoid fever - 486

Descriptors

vector-borne disease
Encephalitis
Tularemia
Anthrax
Spotted Fever
Murine Typhus
Salmonellosis
Malaria
Typhoid Fever

Disease/Solid Waste Abstracts

No. DSW- 352

Author

M. E. McKee

Title

Research Needs in Ground-Water Pollution

Reference

J. Water Pollution Control Federation

Doc. No.	Contract No.	Date issued
V. 33, pgs. 1227-1233		Dec. 1961

Abstract

Insofar as scientific disciplines are involved, the research needs in ground-water pollution may be classified into the following major groups: (a) chemical, (b) physical, (c) biological, (d) geological, and (e) mathematical. There is a need to know the rates of adsorption, desorption, and ion-exchange for each chemical substance and combination of chemicals in aqueous solution passing through specific types of soil. Questions about nitrogen and sulfur compounds are especially relevant to the percolation and recharge of ground waters by organic industrial wastes and sewage. Such waters are not likely to be sterile, although the travel of micro-organisms may be limited to a short distance.

Chemical reactions brought about by biological processes have long been subject to quantitative evaluation in surface waters. In the ground, however, they are much more difficult to assess and as a result, relatively little is known about reaction rates, mechanisms, pathways, intermediate steps, and end products.

Ground water differs from surface water, insofar as biochemical degradation is concerned, in several important ways. First, the ratio of surface area of the soil to the quantity of flow is tremendous in ground water. This area-volume ratio will influence the rate of biochemical phenomena, for many of these reactions are accelerated by the presence of large surface areas. Second, detention periods are long, so that even the slower reactions may go far toward completion. Third, ground waters are often anaerobic and frequently under high pressure. Fourth, higher organisms are readily removed by filtration through soil and consequently biochemical action may be limited to the lower forms or perhaps even to enzyme effects.

There are many problems, that involve the atmosphere in the interstices of soil above the ground-water table or phreatic line.

The problem is brought into sharp focus by the decomposition and stabilization

Descriptors

research
ground-water
pollution
chemical problems
iron
manganese
oxygen
carbon dioxide
methane
hydrogen sulfide
gases
calcium
magnesium
sulfates
sulfur
sodium
potassium
leaching
chromates
borates
fluorides
phosphates
cesium
strontium
mineral ions
nitrogen
sulfur compounds
ammonia
nitrites
nitrogen gas
sulfides
biochemical degradation
physical and mathematical problems
radioactivity
infiltration
clogging
aquifers
biological problems
geology
personnel

Abstract (cointued)

of sanitary land fills. If this organic material is below the ground-water table, or if it is leached by heavy rainfall or irrigation, organic and inorganic substances will enter the ground water. Gases of anaerobic decomposition, such as methane, carbon dioxide, and hydrogen sulfide, are produced. These gases diffuse through the soil and are subject to the laws of fluid dynamics.

Although these general mechanisms can be postulated, little quantitative information is available on the actual occurrence and movement of gases through soil and their relation to the quality of water in the upper fringe of the ground-water table. Additional data are needed on the rates of diffusion of these dissolved gases downward, laterally, and longitudinally through ground water. Knowledge is needed about the mechanics of clogging, whether it be by physical means, chemical action, or biological growth.

How can certain aquifers best be sealed to prevent the travel of pollution?

There is qualitative proof that viruses can travel great distances through aquifers and several outbreaks of hepatitis have been traced to ground water. No virus epidemics other than hepatitis have been so traced. Related to the presence and behavior of bacteria and viruses in ground water are the biochemical problems dependent on enzyme action.

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No. DSW- 353

Author

Graham Walton

Title

Survey of Literature Relating to Infant Methemoglobinemia Due to Nitrate-Contaminated Water

Reference

Am. Journal of Public Health

Doc. No.	Contract No.	Date issued
V. 41:986-96		1951

Abstract

Methemoglobinemia is due to the presence of methemoglobin in the blood. An important cause of cases in infants is the ingestion of water high in nitrate. This review of the literature is concerned with the latter cause. The permissible nitrate-nitrogen concentration in water which may cause infant methemoglobinemia when used in a feeding formula is dependent on the individual's susceptibility, the increase in nitrate-nitrogen concentration due to boiling the water, the quantity of boiled water consumed per day per unit weight of the infant, the duration of exposure to the high nitrate water, and possibly other factors.[8,15,47]

Data indicate that no cases were reported which were associated with water containing 10 p.p.m. nitrate nitrogen or less. In many of these cases clinical data were insufficient for definite diagnosis, and samples of water for the analysis were sometimes collected several months following the occurrence of the case.

Although 10 p.p.m. nitrate nitrogen has been suggested as the permissible levels,[13,47] the A.P.H.A. Committee[89] points out that most of the cases studied were associated with nitrate-nitrogen concentration in excess of 40 p.p.m. and comments that it is "impossible at this time to select any precise concentration of nitrates in potable waters fed infants which definitely will distinguish between waters which are safe or unsafe...." The geographical distribution of high nitrate waters is widespread. Twenty of 37 states reported wells yielding water containing in excess of 50 p.p.m. nitrate nitrogen.

Most cases of infant methemoglobinemia have been associated with water from dug wells. Nearby sources of pollution were believed to be significant by 12 of 22 states reporting on this item. Bosch, et al.,[8] noted that 83 of 129 wells involved in cases of methemoglobinemia were within less than 50 feet from a barnyard, pigpen, privy, cesspool or other source of animal or human contamination.

Descriptors

Methemoglobinemia
methemoglobin
anoxemia
infants
nitrate
nitrites
pollution
contamination
wells
water
coliform organisms
solid wastes
fertilizers

Abstract (continued)

According to Sarles, et al.,[63] the principal sources of nitrogenous matter in the soil are the decomposition products of plants, animals and microorganisms; the liquid and solid wastes of animal metabolism; and fertilizers added to enrich the soil. The possibility of geological formations containing appreciable amounts of nitrates must also be considered.

Maxcy,[47] notes that there is urgent need for further study before comprehensive measures of prevention can be advocated.

Some of the factors which should be investigated are the permissible level of nitrates in waters fed to infants; the factors which predispose some infants to methemoglobinemia, whereas other infants consuming equally high nitrate waters are unaffected; the health of infants routinely consuming water containing high nitrate in regions where methomoglobinemia has not been reported; the fluctuations, if any, in the nitrate content of waters from selected wells, including factors which influence such variations.[47, 89]

References

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[13] Comly, H.H. Cyanosis in Infants Caused by Nitrates in Well Water. J.A.M.A. 129:112-116 (Sept. 8), 1945.

[15] Cornblath, M., and Hartmann, A. F. Methemoglobinemia in Young Infants. J. Pediat. 33:421-425 (Oct.), 1948.

[47] Maxcy, Kenneth F. Report on the Relation of Nitrate Nitrogen Concentration in Well Waters to the Occurrence of Methemoglobinemia in Infants. Bull. San. Eng. and Envir. 264 (or Appendix D), National Research Council, 1950.

[63] Sarles, w. b., Fraxier, W. C., and McCarter, J.R. Bacteriology (Rev. Ed.), Madison, Wis.: Kramer Business Service, 1940.

[89] A.P.H.A. Committee. "Water Supply: Nitrate in Potable Waters and Methemoglobinemia." A.P.H.A. Yearbook 40, 5:110 (May), 1949-1950.

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Abstracts

No. DSW- 354

Author

Major N. Faichnie

Title

Fly-Borne Enteric Fever: The Source of Infection

Reference

Jour. of the Royal Army Medical Corps

Doc. No.	Contract No.	Date issued
V.XIII, pgs. 580-4		1909

Abstract

Caton Jones pointed out that since a raid on flies had been commenced in Nasirabad, in 1904, the enteric fever rate there had very much dimished, and that the results obtained were partly due to a better system of trenching the night soil, by which the breeding of flies was prevented.

In Mhow, there was also a sudden diminution in enteric fever in 1907, which has been maintained ever since. This diminution coincides with the inspection of the station by Surgeon-General Trevor, who found the trenching grounds swarming with flies. Since then a marked change in this respect has followed, and now for eighteen months scarcely a fly has been bred there. This drop in the enteric fever rate is very marked, but it cannot be put down solely to anti-typhoid inoculation, for although the majority of the people in the station have been inoculated, many have not. The Mhow water supply is from a pure source, so there can be very little doubt that the essential cause of the improvement is the fact that flies do not breed in the trenching grounds.

One station may swarm with flies, bred only from the excreta of cows and horses, and yet have no enteric; while another place, where there are very few flies, but where these are bred from human excreta may have an epidemic, the source of infection being the excrement of the flies, and the insects themselves being carriers. It is the breeding ground that constitutes the danger, not the ground where the flies feed.

Descriptors
- flies
- enteric fever
- night soil
- water supply

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Abstracts

No. DSW- 355

Author

Lieutenant-Colonel A.R.Aldridge

Title

House-Flies as Carriers of Enteric Fever Infection

Reference

Jour. of the Royal Army Medical Corps

Doc. No.	Contract No.	Date issued
V.IX.pgs.558-71		1907

Abstract

It is now pretty universally admitted that water-milk, and shell-fish epidemics of enteric fever and direct personal contact, however complete the proof in some isolated outbreaks, fail to account for a very large proportion of the cases; but though for a number of years house-flies have been believed to play a part in its spread, we are still without experimental proof, and in the absence of this preventive measures in this direction are but half-hearted. It may therefore be not unprofitable to review the facts which have been ascertained.

Epidemiological evidence -- The medical literature of the American-Spanish and South African wars, the Army Medical Department and various Indian sanitary reports, contain innumerable illustrations of the close association of epidemics of enteric fever with a great prevalence of flies in dwellings, latrines, and places where food is stored.

Dr. A.B. Dunne says,"...Nothing was more noticeable than the fall in the admissions for enteric fever coincident with the killing off of the flies on the advent of the cold nights in May and June...."

It is a well-ascertained fact that enteric fever is particularly prevalent where dry methods of removal of excreta, such as pail and earth closets and trench latrines, are in use; that is, where flies have ample opportunity of crawling over the excreta, which they have not in water-closets.

There seems to be no doubt that in India, speaking generally, the seasons of greatest prevalence of enteric fever correspond pretty closely with the seasons of greatest prevalence of flies.

One of the most striking facts in the epidemiology of enteric fever in India, is the frequency with which small groups of cases come from one barrack-room or section of a room, to be followed, after an interval corresponding

Descriptors

water
milk
shell-fish
enteric fever
house-flies
latrines

Abstract (continued)

closely with the incubation period of the disease, by another case or cases. As messes are arranged by "sections," fly-infected food and infected latrines would account for this.

A study of the incidence of enteric fever shows that stations where there are no filth trenches, or where they are a considerable distance from the barracks, all have an admission-rate below the average, and all but one less than half the average.

There seems no doubt that the eggs are laid in the excrement in the latrines.

Summary: There is very general agreement among observers that water, milk and shell-fish epidemics and direct personal contact, will not account for a large proportion of the cases of enteric fever among troops in India and on service.

There is a large mass of evidence pointing to the close association of epidemics of enteric fever with a great prevalence of house-flies in dwellings, places where food is stored, and in latrines.

As far as observations up to the present have been made, the seasonal prevalence of flies agrees very closely with that of enteric fever.

Flies are bred at certain seasons of the year in enormous numbers in latrine trenches, and in excrement after it has been buried in comparatively shallow trenches.

Statistics show that, in Indian cantonments with 500 British troops and over, the five having the lowest enteric fever admission-rates have no filth trenches; and in the only remaining ones in which there are no trenches, or only at a considerable distance from barracks, the rates are much below the average.

The persistently-increased prevalence of the disease among mounted troops as compared with dismounted, the occurrence of groups of cases in the same tent or section of a barrack-room so frequently noticed, and the greater incidence in towns and parts of towns where dry methods are in vogue as compared with water carriage of sewage, would all be explained by fly infection.

It has been demonstrated by bacteriological methods, that flies are capable of transferring active bacilli from the excreta of enteric fever patients to culture media.

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Abstracts**

No. DSW- 356

Author

J. R. Ridlon

Title

An Investigation of the Prevalence of Typhoid Fever at Charles Town, W.Va.

Reference

Public Health Reports

Doc. No.	Contract No.	Date issued
V. XXVI, No. 46, pgs. 1789-99		1911

Abstract

A preliminary survey of the situation showed that the possible causes to be considered were much the same as in other localities at this season of the year, namely, (1) water supply; (2) milk supply; (3) ice supply; (4) uncooked fruits and vegetables; (5) other food supplies, including ice cream, shellfish, and bakery products; (6) infection by personal contact; (7) infection by flies; and (8) infection through faulty disposal of excreta.

The most probable source of infection in 5 cases was from flies. These cases were located within 200 feet or less of other cases where the disinfection of stools was inefficient, where there were no screens, and where the abundant flies had free access to both dejecta of patients and the food. That flies under the proper conditions can be a prominent factor in the spread of infection is an undisputed fact, as is also the fact that their prevalence can be greatly limited by proper care of their breeding places, including stable manure, household refuse, and garbage.

The bacteriological examinations of the public water supply show that it is contaminated to a degree highly dangerous to the consumers when used for household purposes.

In regard to the question as to what part the public water supply has played in the causation of typhoid in Charles Town during the present season, evidence is lacking that it has played any considerable part. No cause of typhoid has been reported on the watershed of the public supply during the present season. No case has been reported as occurring in Ranson, which is remarkable in view of the number of people of that city using the public supply. In proportion to population typhoid has been as prevalent in the country as among the residents of Charles Town using the public supply.

Descriptors
water supply
food supplies
ice supply
contact
flies
excreta

Abstract (continued)

Summary: There was an excessive rate of typhoid fever in Charles Town and vicinity during June, July, and August, 1911. An analysis of the histories of the cases points to several probable sources of infection. In 10 cases the most probable source of infection was from contact with other patients in the febrile stage of the disease.

In 5 cases the most probable source of infection was from flies, these cases being located in the vicintiy of other patients where proper precautions were not always taken.

Although only one case was attributed to milk, it is probable, takeing into account the age of the patients and the lack of supervision over the milk supply, that milk played a more important part as the cause of sickness.

Evidence is lacking that the public water supply has played more than a minor part in the causation of typhoid.

As is usual in any series of cases, in several instances no one cause can be decided upon as the most probable. This is due to the varied conditions under which people mingle in their business and social relations and to the varied sources of supply of water and food.

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Abstracts

No. DSW- 357

Author

Morris Ostrolenk and Henry Welch

Title

The Fly as a Vector of Food Poisoning Organisms in Food Producing Establishments

Reference

Am. Journal of Public Health

Doc. No.	Contract No.	Date issued
V.32:487-94		1942

Abstract

The results of related experiments indicated that the test organism could survive for the entire duration of the life of the fly, approximately 4 weeks. Extremely small inocula (per os) of the strain of Salmonella enteritidis used in these experiments were necessary to bring about infection and subsequent excretion of the organism in both rats and mice.

Discussion: In our preliminary studies of this problem we were able to demonstrate that flies are an extremely potent source of pollution organisms, particularly in those food plants where little attention is paid to sanitation and where the food is prepared for the consumer without a final treatment to destroy these organisms.

Salmonella enteritidis may be transmitted with ease and rapidity through several populations of flies, and that all surfaces with which the infected fly comes in contact become potential sources of reinfection for other insects. Our studies show that not only does the fly carry the organism on its outside surfaces, but also in its digestive tract. The ease of transfer of food poisoning organisms from fly to fly and the fact that such organisms survive in the fly for practically the entire life span of these insects lends added significance to their potentialities as sources of food poisoning outbreaks.

The transfer of food poisoning bacteria by flies to mice and the subsequent retransfer from infected mice to flies, with apparent ease of transmission of infection, mark these insects as potential health hazards wherever food that is to be eaten raw is being prepared. Flies breeding in infected material can give rise to infected maggots, pupae, and adults. The removal of waste and refuse from the vicinity of food producing plants, adequate protection by screening to prevent fly contact with food, and the elimination of flies from such establishments are essential in plant sanitation.

Descriptors

food poisoning
house fly
Musca domestica
vector
food poisoning bacteria

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No. DSW- 358

Author

A. Leboeuf

Title

Dissemination of Hansen's Bacillus by the Domestic Fly

Reference Bulletin de la Societe de Pathologie Exotique, Institut Pasteur, Paris

Doc. No.	Contract No.	Date issued
V.5 pgs. 860-8		1912

Abstract (Translation by G. T. Hanks)

Summary: Musca domestica can take up enormous quantities of Hanson bacilli in feeding on bacillus-containing ulcers. Hanson bacilli can be recovered in abundance and in apparently excellent condition from the digestive tracts of flies so infested.

M. Domestica perhaps plays an important role in the spread of leprosy through depositing its excrement on the mucosa or wounds of the skin of healthy persons living in the immediate vicinity of lepers exhibiting open and bacillus-containing lesions.

Descriptors

Musca domestica
flies
Hansen bacilli
excrement
mucosa
wounds
skin
excrement
lepers

Disease/Solid Waste
Abstracts

No. DSW- 359

Author

M. B. Mitzmain

Title

Experimental Insect Transmission of Anthrax

Reference

Public Health Reports

Doc. No.	Contract No.	Date issued
V. 29, pgs. 75-77		1-9-14

Abstract

The problem of anthrax dissemination is not significant for the auctorial insect until the peripheral circulation becomes invaded with tremendous numbers of the anthrax bacterium

Only negative results were obtained when it was aimed to demonstrate the possibility of biting fly transmission with animals recently dead of the disease. Both Stomoxys calcitrans and Tabanus striatus were employed in six experiments in the direct method. The primary host in these instances was used 10 minutes after death.

Guinea pigs were used to receive the infective bites of Stomoxys calcitrans. The stable flies were transferred to the healthy animal in one trial with only a few seconds' interval after biting the infected host, and in the other instance an interval of 10 minutes elapsed between the feedings. A total of 20 flies were used in the first experiment and 30 flies in the second trial.

The exposed animals died in both cases during the evening of the third day. Typical pictures of anthrax infection were presented at the necropsy of the two animals. Pure cultures were obtained from the spleens of the dead animals.

Similar results were obtained in all essentials when horseflies were employed to transfer the disease from the sick to a healthy guinea pig.

Typical organisms were seen in the feces of hoseflies at various intervals up to 48 hours from the time the infected animal was bitten. The feces of the stable fly were likewise found to be infected up to 24 hours after obtaining blood from a sick animal.

Descriptors

insect
transmission
anthrax
biting fly
Stomoxys calcitrans
Tabanus striatus
guinea pigs
stable flies
horseflies
feces
cattle
horses

Disease/Solid Waste
Abstracts

No. DSW- 360

Author

R. M. Buchanan and F.F.P.S. Glasg

Title

The Carriage of Infection by Flies

Reference

The Lancet

Doc. No.	Contract No.	Date issued
V.II for 1907, pgs. 216-18		1907

Abstract

The flies used in the experiments were the common housefly (Musca domestica) and the bluebottle (Musca vomitoria). The flies were allowed a limited contact with infective material and then transferred directly to the surface of a solidified nutrient medium in a Petri capsule, and in some instances to a succession of such surfaces.

The diseases which were made the subject of the experiments were typhoid fever, swine fever, staphylococcal abscess, pulmonary tuberculosis, and anthrax.

Typhoid fever: Experiment 1.--A few colonies of coliform organisms appeared on three of the nutrient surfaces but no trace of bacillus typhosus was found.

Experiment II-- No growths resulted in any of the capsules.

Experiment III-- From two of the faecal films the flies were found to have carried typhoid bacilli to the surface of the nutrietn medium, but the number of these bacilli was relatively very small. No typhoid bacilli appeared on the second and third surfaces traversed by the flies.

Swine Fever -- Experiment IV--The bacillus of swine fever was isolated from one of the capsules.

Staphylococcal Abscess. Experiment V--The agar showed a profuse mixed growth in which staphylococcus aureus predominated.

Pulmonary Tuberculosis. Experiment VI-- On washing the surface of the agar with one cubic centimetre of bouillon and inoculating a guinea-pig intraperitoneally therewith, tuberculosis was induced which killed the guinea-pig in 36 days.

Anthrax. Experiment VII--Incubation brought forth on both agar surfaces a very profuse growth of bacillus anthracle.

Experiment VIII--produced a profuse growth of several species, amonst which were found two colonies of bacillus anthracis.

Descriptors

housefly
Musca domestica
bluebottle
Musca vomitoria
typhoid fever
swine fever
staphylococcal abscess
pulmonary tuberculosis
anthrax

Abstract (continued)

The experiments conclusively show that flies alighting on any substance containing pathogenic organisms are capable of carrying away these organisms in large numbers on their feet and of depositing them in gradually dimishing numbers on surface after surface with which they come in contact. They further serve to demonstrate the necessity for the exercise of stringent measures to prevent the access of flies to all sources of infection and to protect food of all kinds against flies alighting on it.

Disease/Solid Waste Abstracts

No. DSW- 361

Author

Lieut.-Colonel C.A. Gill and R.B. Lal

Title

The Epidemiology of Cholera, with Special Reference to Transmission. A Preliminary Report

Reference

The Indian Journal of Medical Research

Doc. No.	Contract No.	Date issued
Vol.XVIII,No. 3		Jan.1931

Abstract

Summary: The experiments recorded above are admittedly meagre, and it is not at present claimed that they justify the conclusion that a true host-parasite relationship exists between the fly and the vibrio. It would, however, seem in the first place that the vibrios are capable of surviving in the fly for a period of at least five days. Secondly, it would appear that the cholera vibrio apparently disappears from the body of the fly after 24 hours or so, but that it re-appears on or about the fifth day, at which time the fly is capable of infecting food by its faeces. Thirdly, it has been shown that infection of milk via the proboscis can take place up to 24 hours, but it has not yet been proved that infection via the proboscis can take place on and after the fifth day.

It would be premature at present to discuss the significance of these observations, but they seem to suggest that possibly one phase of the life-cycle of the cholera vibrio is passed in the body of the house-fly and that this insect may play a more important part in the transmission of cholera than has histherto been suspected.

Conclusion: The most striking result of the investigation is undoubtedly the suggestion that cholera may perhaps have to be numbered amonst the insect-borne diseases. The cholera vibrio may perhaps be sometimes disseminated through the medium of water and sometimes, more especially in tropical countries, by the agency of houseflies. It would moreover appear that in hot countries insect transmission is of predominant importance and that the strikingly dramatic outbreaks associated with the massive pollution of water are relatively rare incidents, if not accidents, in the natural history of the disease.

Explosive epidemics which appear, indubitably, to be due to the massive pollution of drinking water are, it has been shown, of infrequent occurrence.

Descriptors

epidemiology
cholera
transmission
fly
vibrio
milk
epidemics
water
night-soil
refuse

Abstract (continued)

The provision of piped water-supplies and the rigorous disinfection of the drinking water, combined with other routine measures, in the absence of measures designed to eliminate the gravely insanitary conditions which almost universally prevail in Indian towns, have proved of little value. Even under the most favorable conditions it is not possible to prevent the entry of acute 'carriers' into uninfected areas.

It has been shown that more than half the outbreaks of cholera are limited to a few seizures and that it is mainly in towns where conservancy arrangements are peculiarly defective that importation occasions, after an interval, a protracted epidemic. In these circumstances it would appear that one of the most important, if not the most important, method of controlling cholera is the provision of an efficient system of sanitary control, more especially in connection with the collection, removal and disposal of night-soil and refuse.

Disease/Solid Waste Abstracts

No. DSW- 362

Author Sally Kelly, Johan Winsser, and Warren Winkelstein, Jr.

Title

Poliomyelitis and Other Enteric Viruses in Sewage

Reference

Am. Journal of Public Health (N.Y.)

Doc. No.	Contract No.	Date issued
V. 47(1): 72-7		Jan.1957

Abstract

Three hundred and eight sewage samples were tested for pathogenic agents in newborn mice. Two hundred and eight of them (Series B) were tested for cytopathogenic agents in HeLa cells[1] and the remaining 100 (Series A) in monkey kidney epithelium[2] cultures. Series B samples were raw sewage from communities of various socioeconomic levels in Erie County and Series A samples, sewage from stages of treatment in Albany and environs.

Most of the isolates were identified as poliomyelitis or Coxsackie viruses. Agents isolated in mice were Coxsackie viruses and those in tissue cultures were poliomyelitis or Coxsackie viruses, or unknown. Poliomyelitis viruses were found in 21 per cent of the samples; Coxsackie viruses in 42 per cent; both poliomyelitis can Coxsackie viruses in 13 per cent; and unidentified agents in 3 per cent.

Both poliomyelitis and Coxsackie viruses occurred in similar seasonal patterns. Thus, neigher was found until early summer and appeared regularly through fall. Of the poliomyelitis viruses, Type 1 was encountered most frequently (Table 1). Type 3 was also commonly encountered in Erie County. Type 2 was the least often found. Mixtures of two or more poliomyelitis types, of Coxsackie types, or of poliomyelitis and Coxsackie viruses occurred in many of the samples.

The samples from Erie County were collected in a manner designed to determine relationships between the socioeconomic level of a community, virus presence in sewage, and incidence of paralytic disease. It is difficult from the data given to recognize relationships among these factors.

The choice of host is a critical factor in the isolation and identification of agents. Tissue culture hosts are excellent for isolation of poliomyelitis viruses. Newborn mice, on the other hand, are of no value for isolations of poliomyelitis virus; for Coxsackie A virus isolations, however, they exceed that of tissue culture hosts.

Descriptors

poliomyelitis
enteric viruses
sewage
mice
monkey kidney
socioeconomic levels
Coxsackie viruses
tissue culture

Disease/Solid Waste Abstracts

No. DSW- 363

Author

Joseph L. Melnick and Richard P. Dow

Title

Poliomyelitis in Hidalgo County, Texas, 1948; Poliomyelitis and Coxsackie Viruses from Flies

Reference

Am. Journal of Hygience

Doc. No.	**Contract No.**	**Date issued**
V.58: pp. 288-309		1953

Abstract

The occurrence of poliomyelitis virus in flies has suggested one hypothesis to explain the sharp seasonal epidemics of the disease. Among the supporting points for this hypothesis may be listed the following: (a) the oral route is the most likely portal of entry of the virus in man; (b) flies are common contaminators of food and actually food exposed to fly contamination in an epidemic area has been found to contain poliomyelitis virus (1); and (c) flies experimentally fed poliomyelitis virus from human stools may continue to excrete virus for as long as 2 weeks(2).

Further studies are needed to evaluate the importance of flies in the transmission of poliomyelitis during epidemics. Of assistance would be the determination of (a) whether virus is more prevalent in flies or in the human population during endemic and epidemic periods; (b) whether virus is distributed in the fly population before it is widely seeded in the human population, or vice versa; (c) whether cases are concentrated in areas where virus can most readily be isolated from flies; and (d) whether virus carriage is limited to certain fly species. Some new information has been obtained on all these 4 points in this study, although the question posed in the first sentence of this paragraph remains unanswered.

The finding of poliomyelitis virus in all 3 major fly genera in Alamo during May is of note, in view of the absence of clinical cases there. The finding of virus in privies during May in the same part of town (5) indicates that poliomyelitis infections were common in spite of the absence of paralyzed cases. Also it emphasizes the difficulty in evaluating the effect of the fly control program in this area(4), for we have no knowledge of the ratio of persons infected with poliomyelitis virus to clinical cases in Hidalgo County in 1948.

Descriptors

disease
vectors (flies)
polio
coxsackie
viruses
poliomyelitis
flies
Musca
Phaenicia
Sarcophagula

Abstract (continued)

Paffenbarger and Watt (4) have directed attention to the high frequency of cases among contacts in this epidemic. This suggests that the paralytic case is markedly more infectious than the inapparent carrier. Another interpretation is that the environment to which the paralytic case and his contact have been exposed is highly contaminated with virus. If "infected place" is substituted for "contact" in Paffenbarger and Watt's discussion, an entirely different reading may be obtained from their observations. If place of infection may be considered as an important factor in poliomyelitis, then the finding of a high percentage of patients giving a history of contact becomes, instead of a cause and effect relationship, simply an indication of mutual association with this other source of virus. The occurrence of virus in flies may be another index of the infected place, or perhaps at times an actual source of infection at the place. Intimate contact between persons is of unquestionable importance in the transmission of poliomyelitits. The problem which still remains unsettled is to what extent the added dissemination of virus by flies contributes to the marked seasonal pattern of the usual poliomyelitis outbreak.

There does not appear to be a true host-aprasite relationship in regard to the poliomyelitis and C viruses and flies.

The amounts of virus recovered in the excreta of flies gave no evidence of multiplication of the viruses in their sojourn through these insects.

Summary: A study has been made of the prevalence of poliomyelitis virus and of Coxsackie (or C) viruses in flies, and their changes in prevalence with respect to time, during the the 1948 poliomyelitis epidemic in Hidalgo County located in the lower Rio Grande Valley of Texas.

Poliomyelitis virus was more prevalent in flies during the peak of the epidemic than later.

There appeared to be a correlation between the finding of poliomyelitis virus in flies and in privy specimens collected in the same area, the latter findings being reported in a corrollary study by Francis, Brown, and Ainslie(5).

In one area flies were collected 3 weeks before onset of paralytic poliomyelitis in 3 patients. Three of 6 samples of *Phaenicia* (*sericata* and *pallescens*),

In one town which was free of cases, all 3 major fly genera were contaminated with poliomyelitis virus during May but no thereafter.

There does not appear to be a true host-parasite relationship in regard to poliomyelitis virus and flies. The virus was prevalent to the same degree in the 3 major genera of flies: *Musca*, *Phaenicia*, and *Sarcophagula*. The same may be said for C viruses.

Poliomyelitis virus found in flies was able to infect both cynomolgus and rhesus monkeys.

References

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[4] Paffenbarger, R., and Watt, J. Poliomyelitis in Hidalgo County, Texas, 1948. Epidemiologic observations. Amer. Jour. Hyg., 1953, 58: 269-287.

[5] Francis, T., Jr., Brown, G.C., and Ainslie, J.D. Poliomyelitis in Hidalgo County, Texas, 1948. Poliomyelitis and Coxsackie Viruses in privy specimens. Amer. Jour. Hyg., 1953, 58: 310-318.

Disease/Solid Waste
Abstracts

No. DSW- 364

Author

Thomas Francis, Jr., Gordon C. Brown, and John D. Ainslie

Title

Poliomyelitis in Hidalgo County, Texas, 1948; Poliomyelitis and Coxsackie Viruses in Privy Specimens

Reference

Am. Journal of Hygiene

Doc. No.	**Contract No.**	**Date. issued**
V. 38: pp. 310-318		1953

Abstract

As with the isolation of poliomyelitis virus, the yields of Coxsackie viruses from privies and from flies were in general agreement.

Discussion: The recovery of poliomyelitis virus from specimens of stools in outsoor privies is a significant finding from several points of view. First, it demonstrates that this agent can survive in demonstrable quanitites the conditions of heat and exposure to air and drying to which it had been subjected prior to collection for study.

However, the sampling of privies made during the Diarrheal Disease Control study was by no means complete enough to permit such an estimate in the 4 communities included in this study. For one thing, the areas represented were inhabited solely by Latin-Americans. The Anglo-Americans, among whom the case rates were considerably higher, lived in areas which had a city sewage disposal. Relatively few blocks in each town were sampled and in many instances, specimens were taken at only one time which frequently was not the best time for demonstrating virus. With few exceptions the areas sampled were not those in which cases of poliomyelitis had occurred.

In Donna virus was less frequently isolated even from blocks as near as possible to the two paralytic cases. Thus, in these two towns the number of virus isolations was consistent with the degree of clinical epidemicity of the disease. However, virus was isolated from privies in Alamo which did not have a recognized case of poliomyelitis. The results would obviously reflect the prevalence of subclinical infections in the area, although an adequate estimation of their extent is impossible with the data available.

An interesting result is the failure to demonstrate virus in privy samples from McAllen in which the greatest number of cases occurred. Most of them were reported prior to the collection of privy specimens.

Descriptors

disease
viruses
poliomyelitis
coxsackie
viruses
privy specimens
epidemic

Abstract (continued)

In general, there was a good correlation between the presence or absence of poliomyelitis virus in privy specimens and in the flies tested by Melnick and Dow (2) in areas of the 4 towns in this study. When virus was demonstrated in privy samples, the flies also were positive, and similarly when privies in areas yielded little or no virus, flies also tended to be negative. It is not intended that these data be applied to the significance of flies as possible vectors of the disease, but rather that additional evidence is provided of the mutual contamination of these kinds of specimens during epidemic periods

Summary: Specimens of stools from privies in 4 towns in Hidalgo County, Texas, were collected during an epidemic of poliomyelitis in 1948. The specimens were tested for the presence of poliomyelitis virus and for Coxsackie viruses by animal inoculation.

A marked correlation existed between the presence or absence of poliomyelitis virus isolations from privy specimens and from the flies tested in a corollary study by Melnick and Dow (2).

In a community where privies are the essential depositories of fecal contamination, the privy sample can be employed to estimate the distribution of poliomyelitis virus in various parts of the community. The occurrence of subclinical infection was emphasized in one town where virus was recovered but no case had been seen.

The possible significance of the findings is discussed.

Disease/Solid Waste Abstracts

No. DSW- 365

Author

Joseph L. Melnick

Title

Isolation of Poliomyelitis Virus from Single Species of Flies Collected During an Urban Epidemic

Reference

Am. J. Hyg.

Doc. No.	**Contract No.**	**Date issued**
V. 49:pp. 8-16		1949

Abstract

For several days after flies have ingested human virus, inoculation of such flies or their excreta may produce infection in rhesus and Ceropithecus as well as cynomolgus monkeys. What we do not yet know is where flies in nature obtain their virus, although from their habits it is known that they may feed on human excrement.

Summary: In an attempt to determine possible correlations between single species of flies and poliomyelitis, over 93,000 flies trapped at random throughout an urban area during an epidemic were identified and examined for poliomyelitis virus by species during the course of the epidemic. Cynomolgus monkeys were used as test animals for virus.

At the peak of the epidemic, only the blow flies, Phormia regina and Phaenicia sericanta yielded positive tests.

Two weeks later in the epidemic, the positive species were Phormia regina, and in addition the common house fly, Musca domestica, and flesh flies, Sarcophaga spp. In the next 2-week period no positive isolation was obtained from any of the species. In the last 2-week period when the epidemic had practically ceased, all species were negative with the exception of Cynomyopsis cadaverina. This species was not present during the height of the epidemic and only came into prominence during the last 2-wekk period when it was found to be carrying virus.

Of 12 cynomolgus monkeys inoculated with virus containing flies, 7 developed experimental poliomyelitis; whereas of 14 rhesus monekeys, two developed the disease.

Descriptors

vectors
poliomyelitis
virus
flies
epidemic
blow flies
Pharmia regina
Phaenicia sericata
house fly
Musca domestica
flesh flies
Sarcophaga spp.
monkeys

Disease/Solid Waste Abstracts

No. DSW- 366

Author

A. B. Sabin and R. Ward

Title

Insects and Epidemiology of Poliomyelitis

Reference

Science

Doc. No.	**Contract No.**	**Date issued**
V.95, pgs. 300-01		1942

Abstract

In Science for February 13, Professor Charles T. Brues discussed our report on flies as carriers of poliomyelitis virus[1] and probably expressed the feeling of many entomologists when he referred to our description of the insects as "naively vague" although he was kind enough to add "for an otherwise carefully executed experiment." The purpose of this communication is to remove some of this "naive vagueness" by reporting certain data which have come to light since the publication of our original note, and to comment on the possible role of insects in the epidemiology of poliomyelitis.

By this time we have been able to demonstrate the presence of poliomyelitis virus in 8 of the 15 batches of flies trapped during outbreaks of the disease in Atlanta and Cleveland. With one exception, the positive results we obtained were with insects that were not caught in the vicinity of privies. Our patients had been in the hospital for days or weeks and the other probable virus carriers in the city homes used good toilets. Where these insects got their virus is one of the intriguing problems for the future.

The distinctly positive results which we obtained with collections of insects consisting only of flies leaves no doubt that they are carriers of the virus. In Atlanta the bait consisted of sliced bananas sprinkled with sugar, and more than 95 per cent. of the flies consisted of Musca domestica; the virus was isolated from 1 of 3 batches tested and the flies in the positive sample consisted of 203 specimens of Musca domestica and 5 blowflies of which 3 can be classified as Calliphoridae: Phaenicia sericata (Mg.). In Cleveland fresh meat was added to the bananas and sugar, and the specimens which were caught and shown to carry the virus consisted of flies, 90 to 95 per cent. of which belonged to the

Descriptors

poliomyelitis
insects
flies
Musca domestica
Calliphoridae
blowflies
Phaenicia sericata

Abstract (continued)

Calliphoridae (Blowflies) and the remainder to the family of Muscidae. The virus was demonstrated in 7 of the 12 batches tested. We were unable to obtain positive results with Rhesus monkeys, and because Cynomolgi are needed, these studies will probably have to be postponed.

Because we have recently been able to domonstrate the presence of poliomyelitis virus in the blood of Cynomolgus monkeys paralyzed after oral infection with a strain of recent human origin (unpublished data), we believe that blood-sucking and biting insects should not be completely left out of consideration. Perhaps the reason the experiments of Rosenau and Brues[2] and of Anderson and Frost[3] on the experimental transmission of poliomyelitis from monkey to monkey by means of the biting stable-fly (Stomoxys calcitrans) could not be repeated by the same workers nor by others, is that a strain of sufficiently recent human origin may not have been used in the later experiments, rather than that epizoic parasites like fleas may have escaped attention, as Professor Brues suggests.

In recent weeks we have been able to convince ourselves of the existence of winter poliomyelitis by isolating the virus from the stools of one paralytic and one non-paralytic case in Cincinnati in the middle of January, as well as from an apparently healthy younger sibling of each of these patients.

We believe that the search for a reservoir of poliomyelitis virus among lower animals is worth while and should continue. It is also evident, however, that epidemiologically poliomyelitis seems more to resemble diseases like typhoid fever and dysentery in which the chief reservoir of infection is in human excreta and both direct and insect spread may be possible.

Having isolated the virus from winter cases, we are inclined to regard poliomyelitis as a disease which occurs the year round but has a greater incidence during the summer and autumn because greater dissemination of the firus may be made possible by a number of factors, including insects such as flies.

References

[1] A.B.Sabin and R. Ward, Science, 94: 590, 1941

[2] M. J. Rosenau and C. T. Brues, Bull. State Bd. Health, Massachusetts, 7: 314, 1912

[3] J. F. Anderson and W. H. Frost, U.S. Public Health Repts., 27: 1733, 1912; ibid., 28: 333, 1913.

Disease/Solid Waste Abstracts

No. DSW- 367

Author

J.R. Paul and J.D. Trask

Title

The virus of Poliomyelitis in Stools and Sewage

Reference

Am. Medical Association Journal

Doc. No.	**Contract No.**	**Date issued**
V.116, pgs. 493-7		1941

Abstract

The present report describes the use of stool tests among a small group of persons during a rural epidemic in western Connecticut which occurred in the summer of 1939. It became apparent that all the members of six related families who lived in three houses there had been exposed.

Up to this point this epeidemic was a family affair, but subsequently the epidemic took a different turn.

This distributional relationship which the epidemic bore to the Naugatuck River (which drains off sewage and industrial waste from the city of Waterbury) implied that some factor existed in this epeidemic which had to do with this watercourse. River epidemics like this one are not new or unique.

Tests of water from the Naugatuck River for virus in this epidemic were not made. Nevertheless, from tests made elsewhere during the summer of 1939 it has become apparent that the virus of poliomyelitis may be present in sewage and that it may be transported for short distances by flowing sewage.

Comment and Summary: From these laboratory experiences it appears that newer methods of testing human feces and sewage have been of assistance in detecting the existence of the virus of poliomyelitis throughout an infected community during epidemic times.

We believe, as do others, that poliomyelitis is probably transmitted from one person to another by a number of different channels. Among these is the direct or indirect factor of close and intimate contact between infected persons, illustrated by the type of interfamilial contact in which juvenile members of a family usually share. Many of these infected persons may be convalescent carriers in the first few weeks of their recovery from either a diagnosed or a missed case; some of the exposed persons may become transient "healthy" carriers. But theoretically there

Descriptors

virus
poliomyelitis
stools
sewage
epidemic
families
watercourse
feces
community
contact
carriers
food
insects
mammals
birds

Abstract (continued)

there may also be a variety of other channels in which contaminated food, milk and water, or conceivably insects, mammals or birds, play a part. That watercourses, and particularly watercourses polluted with sewage, may be related to one of these channels is suspected.

Disease/Solid Waste
Abstracts

No. DSW- 368

Author

J. F. Anderson and W. H. Frost

Title

Transm. of poliomy. by means of the
stable fly stomoxys calcitrans

Reference

Public Health Reports

Doc. No.	Contract No.	Date issued
V. 27, pgs. 1733-35		1912

Abstract

To summarize, three monkeys exposed daily to the bites of several hundred Stomoxys, which at the same time were allowed daily to bite two intracerebrally inoculated monkeys, developed quite typical symptoms of poliomyelitis eight, seven, and nine days respectively from the date of their first exposure.

In order to confirm the diagonis of poliomyelitis in rhesus No. 243, 1 c.c. of an emulsion of the cord of this monkey was injected intracerebrally on October 14 into a healthy monkey (rhesus No. 250). This animal recovered promptly from the operation and remained apparently quite well till the morning of October 17, when a partial paralysis of the right fore leg was noted, progressing somewhat during the day. On the morning of October 18 both fore legs were completely paralyzed and the hind legs weak. In the afternoon of the same day the right hind leg was completely paralyzed, the left very weak, and the neck paralyzed. The monkey died at 10.30 p.m. and was immediately placed on ice until autopsy could be made at 9 a.m. October 19.

Histologic examination of the cord showed lesions characteristic of poliomyelitis, intense congestion and perivascular infiltration, foci of round-cell infiltration here and there in the gray matter, destruction of the cells of the anterior cornu, and small hemorrhages in the anterior and posterior cornu.

Conclusion: These results, in confirmation of those announced by Dr. Rosenau, would seem to demonstrate conclusively that poliomyelitis may be transmitted to monkeys through the agency of the stable fly (Stomoxys calcitrans). It remains for further work to decide whether this is the usual or the only method of transmission in nature.

Descriptors

poliomyelitis
stable fly
Stomoxys calcitrans

Disease/Solid Waste
Abstracts

No. DSW- 369

Author

M. J.Rosenau and C. T. Brues

Title

Some exper. obser. upon monkeys concerning the transmission of poliomyletus through the agency of stomoxys calcitrans

Reference

Public Health Reports

Doc. No.	Contract No.	Date issued
V.27, pg.1593		1912

Abstract

Prof. M. J. Rosenau, of Harvard University, announced at a meeting of the Fifteenth International Congress on Hygiene and Demography at Washington, September 26, that he had apparently succeeded in transmitting poliomyelitis (infantile paralysis) from sick to well monkeys by the bite of the common biting fly, Stomoxys calcitrans. He allowed a number of these flies to bite monkeys sick with poliomyelitis in various stages of the disease and then later allowed these same flies to bite 12 well monkeys. Of the 12 well monkeys thus bitten 6 became sick with well-marked symptoms of poliomyelitis, and of these, 3 died. Three of the 6 monkeys thus infected had disrrhea and symptoms of enteritis during the course of the illness.

Descriptors

poliomyelitis
Stomoxys calcitrans
monkeys

Disease/Solid Waste Abstracts

No. DSW- 370

Author

Charles T. Brues and Philip A.E. Sheppard

Title

The Possible Etiological Relation of Certain Biting Insects to the Spread of Infantile Paralysis

Reference

Journal of Economic Entomology

Doc. No.	Contract No.	Date issued
V.5, No.4, pgs. 305-24		Aug. 1912

Abstract

The writers, together, during the months of August, September and October of 1911, visited the Massachusetts cities and towns named hereunder, undertaking a careful and intensive study of the insect life and history in the environment of cases. With very few exceptions all the cases in the various towns were located either in dirty, unsanitary parts of the town, or were characteristically rural.

Summary: Northing absolutely definite has hietherto been ascertained regarding the channels of infection of acute epidemic poliomyelitis. Many facts connected with the distribution of cases and the spread of epidemics of this disease together with histories of insect bites suggest at least that the disease may be insect-borne.

Field work during the past summer together with a consideration of the epidemiology of the disease so far as known, points strongly toward biting flies as possible carriers of the virus. It seems probable that the common stable fly (Stomoxys calcitrans L.) may be responsible to a certain extent for the spread of acute epeidemic poliomyetitis, possibly aided by other biting flies such as Tabanus lineola. No facts which disprove such a hypothesis have as yet been adduced, and experiments based upon it are now in progress.

Descriptors

poliomyelitis
insect bites
stable fly
Stomoxys calcitrans L.
biting flies

Disease/Solid Waste Abstracts

No. DSW- 371

Author

John S. Wiley

Title

Pathogen Survival in Composting Municipal Wastes

Reference

J. Water Pollution Control Fed.

Doc. No.	Contract No.	Date issued
p80		Jan. 1962

Abstract

This article is a review of the literature on pathogen survival in composting of various municipal wastes. Selected methods, properly controlled, destroyed pathogens of all categories. Time-temperature relationships and antibiotic inhibitors were found to be important to the destruction.

Descriptors

pathogen survival
composting municipal wastes
eggs
Ascaris
Endamoeba histolytica
Endamoeba coli
protozoa
helminth eggs
intestinal worms
refuse
night-soil
sewage sludge
Salmonellae
antibiotic inhibitors
inhibitors
S. paratyphi
S. cairo
bacterial effects
garbage

Disease/Solid Waste
Abstracts

No. DSW- 372

Author

A. R. Carlucci and D. Pramer

Title

Microbiological Process Report

Reference

Applied microbiology

Doc. No.	Contract No.	Date issued
V.7, pgs. 388-92		1959

Abstract

During recent years, the use of marine outfalls for the disposal of sanitary and industrial wastes has increased greatly and information regarding the fate of bacteria in sea water has assumed public health significance. Unpolluted sea water does not contain large numbers of bacteria, and bacteria which enter the coeans by way of land drainage and sewage outfalls die quickly.

ZoBell and Feltham(1933) concluded that the rapid death of bacteria in sea water was not due primarily to its high salt concentration, and Nusbaum and Garver (1955) stated, "it is believed that the normal saline constituents of sea water are not antagonistic to enteric organisms." It was reported that bacteria survived longer in heat sterilized sea water than in untreated sea water.

Summary: Great numbers of bacteria enter the sea by way of surface drainage and sewage outfalls but, as one proceeds outward from land, an extremely rapid decrease in the numbers of bacteria in the water is observed. Numerous explanations for the decrease in numbers have been suggested. Dilution, adsorption, and sedimentation are factors of importance but they do not account fully for the rapid disappearance of bacteria that enter the sea. The significance of biological factors has been emphasized by various investigators who observed tha the survival of bacteria is greater in heat sterilized sea water than in untreated sea water. Although it has been postulated that predators, bacteriophages, and heat labile toxic substances of biological origin (antibiotics) contribute to the rapid death of bacteria in natural water, the evidence is primarily indirect and, therefore, not conclusive. Hydrostatic pressure solar radiation, temperature, salinity, pH, oxidation-reduction potential, and nutrient availability are physiochemical factors known to influence the activities of microorganisms, but their significance in

Descriptors

marine outfalls
wastes
bacteria
sewage outfalls
water
dilution
adsorption
sedimentation
biological factors
survival
sea water
predators
bacteriophages
toxic substances
antibiotics
Hydrostatic pressure
solar radiation
temperature
salinity
pH
oxidation-reduction potential
nutrient availability

Abstract (continued)

maintaining the bacterial population of the sea at a reduced level remains to be evaluated. Likewise, our present knowledge of the interrealtionships of microorganisms in marine environments must be extended before the bactericidal action of sea water can be explained.

Disease/Solid Waste
Abstracts

No. DSW- 373

Author Sidney Gaines, Yupin Achavasmith, Malinee Thareesawat and Chiraphun Duangmani

Title

Types and Distribution of Enteropathogenic Escherichia Coli in Bangkok, Thailand

Reference

Am. Journal of Hygiene

Doc. No.	Contract No.	Date issued
V. 80:388-394		1964

Abstract

The results obtained in this study indicate that Escherichia coli are significant in diarrheal diseases of infants in Thailand. Approximately 10 per cent of diarrhea patients under the age of 2 years were found to contain E.E.C. serotypes in their stools, in contrast to approximately 0.6 per cent of this age group in the normal population. In the older age groups, on the other hand, the percentage of patients postiive for E.E.C. was less than twice that observed in normal subjects.

Descriptors
enteropathogenic Escherichia coli (E.E.C.)
Pseudomonas
Proteus
Aerobacter
Alkaligenes
Salmonella
Shigella
diarrheal diseases
infants

Disease/Solid Waste
Abstracts

No. DSW- 374

Author

Henry A. Schroeder

Title

Hardness of Local Water Supplies and Mortality from Cardiovascular Disease

Reference

The Lancet

Doc. No.	Contract No.	Date issued
p. 1171		1961

Abstract

Morris and his colleagues, in confirming my earlier study, have established the existence of a factor associated with hardness or softness of water which operates both in England and in the United States and which affects mortality from certain cardiovascular diseases (but not from others). If Japan is included, this factor is related to drinking water in some other ill-defined manner.

Descriptors

water
drinking water
hardness
cardiovascular disease
softness

Disease/Solid Waste
Abstracts

No. DSW- 375

Author Lloyd Florio, Mabel Stewart Miller and Edward R. Mugrage

Title

Colorado Tick Fever

Reference

Journal of Immunology

Doc. No.	Contract No.	Date issued
V. 64, pgs. 257-263		1950

Abstract

Wood ticks were collected from three areas near Denver where cases of Colorado tick fever had presumably been acquired. On the basis of the neutralizing power of one human immune serum, there was but little difference between our laboratory strains and field isolations. The wood tick has thus been shown experimentally to be a vector of Colorado tick fever.

Disease-free adult ticks and their larvae and numphs were allowed to feed on hamsters infected with an established laboratory strain of Colorado tick fever virus, and were then carried through the cycle to the next generation of adults.

The original virus used to infect the ticks was recovered from theprogeny in an unmodified form as measured by the minimal infective dose and neutralizing power of the immune serum.

The virus of Colorado tick fever is transovarially transmitted in the wood tick. Virus acquired in either the larval or nymphal stages is likewise transmitted to the adult.

Descriptors
Colorado tick fever
virus
Dermacentor andersoni
transmission
tick
wood ticks
hamsters

Disease/Solid Waste
Abstracts

No. DSW- 376

Author

R. J. Huebner, et al.

Title

Q Fever Studies in Southern California

Reference

Public Health Report

Doc. No.	Contract No.	Date issued
V.63, pgs. 214-22		1948

Abstract

10 to 20 percent of the dairy cows in the Los Angeles area possessed serum antibodies for Q fever.

Insects and arthropods--Pooled specimens of flies,[11] mosquitoes,[12] and several species of free living mites,[13] collected from alfalfa feed were injected into guinea pigs on a limited scale. Completely negative results were obtained. Spinose ear ticks[14] were injected but tests are not yet complete.

The realtive ease with which R. burneti was recovered from milk of dairies in Los Angeles City and County suggests a high degree of availability of this pathogenic agent to the human and animal populations of the area, since nearly all of this milk is transported about the county before processing and much of it is sold raw. The occurrence of Q fever infection in the human population and a demonstrable widely disseminated source of R. burneti in the same area suggest a causal relationship. Whether or not lmilk represents an effective source of infection to man, however, cannot be determined by the data presented in this report.

Descriptors

Q fever
flies
mosquitoes
mites
milk

Disease/Solid Waste
Abstracts

No. DSW- 377

Author

Lauri Luoto

Title

The Epidemiology of Q Fever in the United States

Reference

Am. Journal of Public Health

Doc. No.	Contract No.	Date issued
V.49, No.3, pgs.334-38		March 1959

Abstract

Human infections were found to result from occupational exposure to infected livestock (cattle, sheep, and goats), from residence near infected premises, or from household use of raw infected milk.[6] There is need for early acquisition of nation-wide data on the occurrence of Q fever.

References

[6] Bell, J. A., and Huebner, R. J. Epidemiological Studies of Fever in Southern California. J.A.M.A. 142:868-872, 1950.

Descriptors

epidemiology
Q fever

Disease/Solid Waste Abstracts

No. DSW- 378

Author

Cornelius B. Philip

Title

Observations on Experimental Q Fever

Reference

Journal of Parasitology

Doc. No.	Contract No.	Date issued
V. 34, pgs. 457-64		1948

Abstract

Coxiella burneti does not appear to be transmissible by *Aedes aegypti*. In titration experiments with the tissues and feces of *Dermacentor andersoni*, it was found that minute dosages were infectious. Feces from infected *D. andersoni* are very rich in rickettsiae. Infection from tick feces, and from infected guinea pig spleen pulp and spleen emulsion penetrated the unbroken skin, as well as the abraded skin of test animals. Animals also became infected when powdered feces were dusted in the nostrils, eyes, and mouth in separate tests.

Infection was recovered from houseflies, *Musca domestica*, caught at large in an animal room in which Q fever infected animals were kept. However, attempts failed to transfer infection from infected to normal guinea pigs kept separately, but in a common cage in which houseflies had free access to both.

Houseflies allowed to feed on moistened, infectious tick feces, and on infected spleen pulp, were found to be contaminated with *C. burneti* when injected into test animals.

Descriptors

feces
Dermacentor andersoni
tick
rickettsiae
houseflies
Musca domestica

Disease/Solid Waste
Abstracts

No. DSW- 379

Author

V. N. Apekhtin

Title

Some Questions on the Epidemiology
and Parasitology of Vector Outbreaks
of Tularemia

Reference

Army Biological Labs. 1966

Doc. No. Contract No. Date issued

Abstract

1. The multi-adaptive properties of Bact. tularense (variety of hosts and carriers) determine the complexity of the epidemiology of tularemia infection and the organization of anit-tularemia measures.

2. In the past, man has been infected with tularemia predominantly by the "contact" and "vector" routes.

The temporary German war-time occupation of a number of districts created conditions there for the mass reproduction of mousetype rodents.

Conditions in the occupied districts and adjacent areas made possible the occurrence of a considerable number of cases of tularemia of the so-called "threshing" (agricultural) and domestic type.

With the liberation of these districts and the resumption of normal household life, a sharp drop in the morbidity of tularemia is noted.

In the organization of tularemia prophylactic measures, the need for measures to prevent vector-produced tularemia must be taken into consideration.

The organization of the prophylaxis of vecotr-produced tularemia demands the wide use of experiences in antimalaria defense against the bite of the anopheles mosquito. However, this is expedient only when the specific peculiarities of the epidemiology and parasitology of tularemia infection by vector are calaculated.

In planning the organization of the prophylaxis of vector outbreaks of tularemia, the concurrent and fundamental problem of typifying the vector foci is introduced.

The problem of typifying vector foci of tularemia must be accomplished by: uncovering the principal epidemiologically dangerous types of blood-sucking arthropods; studying the biology and, especially, the phenology of blood-suckers; studying animals which serve as a reservoir of virus for the carriers; the study

Descriptors

Bact. tularense
tularemia
contact
vector
war-time
rodents
morbidity
prophylactic measures
arthropods
animals
reservoir
blood-sucking arthropods.

Abstract (continued)

of the various methods of actively and passivly combating the blood-sucking arthropods which may be shown to be carriers of tularemia virus.

The data at our disposal on the epidemiology and clinical aspects of tularemia lead to the conclusion that inhalation is the most frequent route of the infection process; in isolated years, this is responsible for about 80% of the cases.

Anti-tularemia measures suitable for protecting man from the bite of two-winged blood suckers must have much in common with the system which protects man from the Anopheles mosquito bite in anti-malarial work. B.V. Voskresensky (1943) writes: "In these cases tularemia prevention is completely analogous to anti-malaria defense measures." To us, it seems this statement is incorrect.

Anti-tularemia defense on the other hand, is aimed at preventing from the bite of many, and possibly of all blood suckers. Anti-malaria defense is based on the well-studies biology of the Anopheles, but the protection of man from the bite of tularemia carrying insects must be based on the incompletely studies biology of many blood suckers.

Disease/Solid Waste
Abstracts

No. DSW- 380

Author

N. R. Dyadichev

Title

Epidemiologic peculiarities of the plague and tularemia caused by different ways of infection

Reference

J. Microbiology, Epidemiology and Immunobiology

Doc. No.	Contract No.	Date issued
No. 3; 8-14		1957

Abstract

The basic specific method of transmitting the agent of tularemia from the organism of one warm-blooded animal to another is by means of the tick.

Descriptors

tularemia
tick

Disease/Solid Waste
Abstracts

No. DSW- 381

Author

Albrecht Braun

Title

Anthrax in Wuerttemberg, A Statistical and Epidemiological Study

Reference

Army Biological Labs, Frederick Md.

Doc. No.	Contract No.	Date issued
Misc. TR 484	(AD 480 140)	1958

Abstract

The communities situated on rivers below tanneries were menaced by spore-containing sludge from tannery sewage, which was carried to valley meadows and pastures during floods. At present, the main danger threatens from the textile industry which processes foreing animal hair.

There is the danger of introducing anthrax in foeign feeds, as shown by isolated outbreaks. Cadaver processing plants.

Descriptors

epidemiology
bacillus anthracis
statistical analysis
diseases
disease vectors
spores
bacteria
infections
purification
processing
wastes (sanitary engineering)
history
anthrax
tanneries
sludge
meadows
pastures
waste water
textile industry
animal hair
hairs
decomtamination
feeds
animal meal
bone meal
cadaver processing plants.

Disease/Solid Waste
Abstracts

No. DSW- 382

Author
Marie L. Emanuel, I.M. Mackerras
and D. J. W. Smith

Title

The Epidemiology of Leptospirosis
in North Queensland

Reference

Journal of Hygiene (Cambridge)

Doc. No.	Contract No.	Date issued
451-484 62(4)pp. 485-494		1964

Abstract

Leptospirosis is a zoonosis that causes appreicable ill health and economic loss in North Queensland. Fourteen serotypes of *Leptospira* were known to infect man in the area, and information on their local distribution and seasonal and occupational incidence had been obtained. The next step in the investigation was to determine the reservoir hosts and estimate their significance.

Wild animals examined comprised 5 monotremes, 643 marsupials, 2355 rodents, 67 bats, 30 birds, 28 reptiles, and 21 toads. Evidence of leptospiral infection was obtained from 223 marsupials, 309 rodents, and 6 fruit-bats.

Domestic animals examined included 137 cattle, 54 pigs, 7 sheep, 34 dogs, 31 cats, and a dairy herd in which there was an epizootic of *pomona* leptospirosis. Again, there was a wide scatter of infection, but, apart from the long-known association of *L. pomona* and *L. hyos* with cattle and pigs, there was no evidence of maintaining hosts in this series.

Descriptors

Leptospirosis
sugar-cane fields
epidemiology
rodents
marsupial
Leptospires
bandicoots
Rattus rattus
rats
R. norvegicus
M. musculus
infection
man
towns
dairy herds
cows
calf
horse
pigs
wild pigs
sheep
dogs
cats

Disease/Solid Waste
Abstracts

No. DSW-383

Author

James V. Walters and Robert R. Holcomb

Title

Isolation of an Enteric Pathogen from
Sewage-Borne Nematodes

Reference

Presented at the 5th Annual meeting of the
Soc. of Nematologists; Daytona Beach.

Doc. No.

Contract No.

Date issued
1966

Abstract

The significant discovery which has emerged from this research is that nematodes ingest enteric bacteria in certain sewage treatment processes and carry them out into the receiving stream. The absolute number of pathoglens found would seem to be of secondary importance. If any enterics are ingested it seems logical to assume that enteric pathogens would be ingested in large numbers if the concentrations were very great in the sewage as would be the case in a local epidemic of a disease like Typhoid Fever.

Descriptors

nematodes
enteric bacteria
sewage treatment
pathogens
concentrations
epidemic
disease
Typhoid Fever
Rhabditidae
chlorine
effluents
vectors
filter
chlorination
Salmonella
coliforms
pollution
Providence Group
Salmonella-like
gasteroenteritis
diarrhea

Disease/Solid Waste
Abstracts

No. DSW- 384

Author

J. C. Panisset

Title

Drug Residues in Animal Products

Reference

Canadian Veterinary Journal

Doc. No.	Contract No.	Date issued
V.6 p. 78-80		Mar.1965

Abstract

Insectides are of major concern from a residue point of view. Residues, present in animal tissues, may result from topical application for parasite eradication, or from the consumption of feed or forage which has been sprayed or dusted.

Chlorinated hydrocarbons accumulate in the fat and persist, making this group more of a problem from a health hazard standpoint than organic phosphates which are more rapidly eliminated.

Descriptors

drugs
food
residues
feeds
insecticides,
pesticides
agricultural chemicals
chlorinated hydrocarbons
organic phosphates
therapeutic agents
health hazards
antibiotics

Disease/Solid Waste Abstracts

No. DSW- 385

Author

World Health Organization; Tech. Report

Title

Principles Governing Consumer Safety in Relation to Pesticide Residues

Reference

World Health Organization, Tech. Report Series; No. 240

Doc. No.	**Contract No.**	**Date issued**
240		1962

Abstract

Pesticides are indispensable to the farmer in his fight against pests and diseases. Without their use, many foods could not be produced economically or perhaps at all, and the yield of all crops could be seriously reduced. Pesticides vary widely in the degree of possible hazard they present to users, consumers of treated crops, farm animals, wild life, and the public. The meeting noted the particular question of the application of pesticides to stored food following harvest and emphasized the importance of using, if possible, compounds that leave either no residue or unquestionably harmless residues.

(1) Residue: A pesticide chemical, its derivatives and adjuvants in or on a plant or animal. Residues are expressed as parts per million (ppm) based on the fresh weight of the sample.

(2) Food factor: The average fraction of the total diet made up by the food or class of foods under discussion. Details of the diet of a country may be obtained from the FAO Food Balance Sheets or other similar data.

It is desirable that samples of treated foods be analyzed for residue content.

The aims of toxicological investigation are to ascertain: (1) the amount of a pesticide to which man and farm animals can be exposed daily for a lifetime without injury; (2) the nature of injuries which will result if an excess is absorbed; (3) means for detecting subclinical effects before they become injurious; (4) therapeutic measures for the treatment of injuries; (5) information which will allow workers to utilize the pesticide safely.

It is important that the experimental studies be performed upon material which is chemically identical with the toxic products which the pesticide will leave in human or animal food. To assure this, the chemical changes wheih the pesticide undergoes from exposure to air, moisture, the enzymes of crops and food, and animals,

Descriptors

consumer
safety
residues
committee
agriculture
pesticides
yield
crops
hazard
farm animals
wild life
public
residue
food factor
acceptable daily intake
permissible level
tolerance
control
toxicological investigation
toxic products
food
wastes
analytical procedures
instrumentation
information service
research needs

Abstract (continued)

as well as any reaction between the pesticide and nutrients by which food may be altered, must be known. In the case of farm animals, it is of great importance to know the fate of a pesticide, and especially its rate of excretion in milk and its concentration in milk products, in eggs and in other animal products.

An investigation should also provide information concening the protection of the health of workers. Studies should therefore include, for example, skin penetration of the pesticide, skin irritation and sensitization, possible corneal injury, and with some pesticides, injury following inhalation. The contamination of human and animal food should be restricted to the lowest possible level. By-products obtained from processing raw agricultural products into human food are often used as farm animal feed. Data on the effect of processing and on the initial and ultimate residues in such agricultrual products are needed. Adequate attention must be given to this aspect, otherwise uncertainly may lead to a restriction on the use of agricultural by-products, such as cannery wastes, sugar-beet pulp and molasses, and of certain oilseed meals, as animal feed.

The over-all approach to the evaluation of safety of a pesticide includes consideration of the operator during application, the worker handling the crop, the human sonsumer of the food product, the farm animal consuming treated plant material, and of wild life. In assessing safety to farm animals, distinction must be made between the effect of pesticides on those which are being raised for slaughter and the welfare and productivity of such animals as are used for breeding stock and draught and which remain on farms for longer periods of time.

Adequate analytical procedures are required for a precise knowledge of the nature and the amount of the residues that are likely to be present in food. Two distinct procedures have to be considered: (1) fundamental research that provides basic knowledge of the behaviour, metabolism and rate of degradation of the pesticide on or in crops and animal products; and (2) the analytical methods for examination of market samples.

Recommendations on research needs:

(1) Research into the differences between the normal metabolism of invertebrates, plants and warm-blooded animals as it relates to the susceptibility of these organisms to possible poisons; this information would be of value in the development of new compounds having a selective toxicity to a particular pest while being essentially non-toxic to man, farm animals and wild life (paragraph 23).

(2) Research on the joint toxic action of pesticides and other chemicals on man and useful animals (paragraph 24).

(3) Research into the effects which pesticides may have upon the nutritive value of food (paragraph 24).

(4) Research into the chemical changes which may take place in the residue during food processing (paragraphs 19 and 31).

(5) Research to develop identification schemes for detecting the presence of any kind of pesticide residue alone or in admixture (paragraph 43).

Disease/Solid Waste Abstracts

No. DSW- 386

Author

William F. Durham

Title

Pesticides Residues in Foods in Relation to Human Health

Reference

Residue Reviews

Doc. No.	**Contract No.**	**Date issued**
V.4 pgs. 34-81		1963

Abstract

The present paper reviews the available data bearing on the hazard to human health of pesticide residues in foods. Although some health hazards are associated with the use of these compounds, a number of health benefits have resulted also. Pesticides promote health directly through the control of insect-vector-borne diseases and indirectly through increased and improved agricultural production of food and fiber. No attempt will be made in this review to summarize the various animal toxicity studies which have been carried out on pesticides.

Workers applying formulations containing compounds of higher toxicity, particularly the more toxic organic phosphorus compounds, are poisoned more often than workers using less toxic materials.

Although there is condierable overlapping in toxicity between the groups, on the average the acute toxicity of the organic phosphorus compounds is somewhat greater than that of the chlorinated hydrocarbon materials. However, the chlorinated hydrocarbon compounds, due to their greater stability, are considerably more of a residue problem than are the organic phosporus pesticides (Durham 1961).

DDD has been shown to cause atrophy of the adrenal cortex.

The toxic effect of chemicals that probably causes the greatest public apprehension is the tendency to produce cancer. The problems involved in estimating the carcinogenic hazard of pesticide residues are complex. Since many chemical compounds are weakly carcinogenic, or require a long period of time to produce their carcinogenic effect, or both, oncological studies require large numbers of animals and long periods of time for completion.

It has been pointed out (National Research Council 1960) that one important problem in calculating the carcinogenic effect of pesticides and other food additives which are present in the general diet is the difficulty of making meaningful

Descriptors

hazard
health
pesticide
foods
toxicity
organic phosphorus
chlorinated hydrocarbon
toxicity
pathology
adrenal cortex
potentiation
neurotoxicity
triorthocresyl phosphate (TOCP
diisopropyl fluorophosphate (DFP)
mipafox (Isopestox)
atropine
cholinesterase
chlorthion
DDVP
demeton (Systox)
diazinon
schradan
carcinogenic effect
aplastic anemia
thrombocytopenia
agranulocytosis
anemias
leukemia
chlordane
lindane
blood dyscrasias
DDT
arsenic
aramite
aminotriazole
thyroid pathology
aldrin
IPC (isopropl-N-phenylcabamate)

Abstract (continued)

epidemiological studies. The virtual impossibility of distinguishing those persons in the general population who have not been exposed to pesticide residues in their diet makes comparison of the incidence of cancer for exposed and unexposed groups an impractical approach to the problem.

Aplastic anemia, thrombocytopenia, agraulocytosis, and various anemias that are not neoplastic may be discussed in connection with the malignant blood dycrasias because some cases are difficult to distinguish clinically from early cases of leukemia.

A total of 411 drugs have been mentioned as possible etiological agents in the 1,195 cases of blood dyscrasias reported to this Study Group during the seven years of its existence (Ersley and Wintrobe 1962). Insecticides have been implicated in some 40 cases. This list includes the insecticides chlordane and lindane. Cronkite feels that benzene is the only chemical which has been definitely implicated as a leukemogen in man.

Hayes (1961) has studied the statistics for the United States for certain blood dyscrasias in relation to the era of the modern synthetic pesticides. The available statistics indicate no increase in agranulocytosis, aplastic anemia, or purpura. There has been some increase in the incidence of Hodgkin's disease and a striking increase in leukemia and aleukemia. There has been no augmentation of this increase associated with the introduction of DDT or with the more recent introduction of other synthetic pesticides.

For some of the pesticides, there is excellent evidence that the chemicals do have a carcinogenic effect. For other pesticides, the available evidence does not seem to support the conclusion that exposure to the chemical is a cause of cancer.

All the evidence relating to a carcinogenic effect for arsenic is based on epidemiologic and other studies in man. No experimental data have yet been published showing that any form of arsenic can give rise to tumors in other animals. This element is a common, naturally-occurring component of many foods, notably fish and shellfish. Milk contains about 0.3 to 0.5 p.p.m. of arsenic on a dry weight basis. It will clearly never be possible to completely eliminate arsenic from the human diet.

Aramite is an effective acaracide. Long-term toxicological study showed that this compound was a carcinogen both for the rat and the dog. Following elucidation of its carcinogenic effect in these two species, a zero tolerance was established for Aramite. No tolerance level greater than zero has been permitted for residues of aminotriazole in any foodstuff. Following a two-week feeding period, rats given 60 or 200 p.p.m. of the compound in their diet showed an enlarged thyroid gland which was associated with a decreased uptake of radioactive iodine. Among the other pesticides that have been implicated as carcinogens by some workers are DDT, aldrin, dieldrin, and IPC (isopropyl-N-phenylcarbamate).

Information on the amount of any given pesticide which may produce poisoning in man is available from several sources, including use experience data, accidental poisoning cases, and human volunteer studies.

Use experience data--The measurement of exposure from residues is more difficult than that from most other sources, particularly from occupational contact, because of the very small quantities of contaminant involved in residues.

The mean daily DDT content of the meatless diet was determined by these authors to be about one-fourth that of the average diet which does contain meat. These findings are in agreement with the report by Walker et al. (1954) that

Abstract (continued)

foodstuffs containing meat, on the average, had a higher DDT and DDE content than did other food items. The average storage in fat for the general population with ordinary dietary habits, with no occupational contact with DDT, and with little or not environmental exposure to the insecticide was found to be 4.9 p.p.m. for DDT and 6.1 p.p.m. for DDE.

In no instance were insecticides found to be a cause of chronic effects or a contributing cause of asthma, influenza, or any other of a wide range of diseases which some have attributed to DDT or to pesticides generally.

b. Accidental poisoning cases and human volunteer studies. Chlorinated hydrocarbon compounds. Recovery from poisoning, when it occurred, was prompt and not followed by sequelae.

There have been innumerable studies done and papers published on the subject of residues of the various pesticides on raw agricultural produce.

Plants and plant products may become contaminated with pesticides in at least the following three ways: (1) through direct application of the chemical to the plant in an attempt to control pests, (2) through drift from adjacent spraying or dusting operations, and (3) from soil containing residue from earlier pesticide applications, possibly from previous years.

Information is available from the U.S. Food and Drug Administration and from the State of California that gives an indication of the amount of raw agricultrual produce in the United States containing pesticde residues in excess of the tolerance levels.

Some writers have expressed concern that the average level of pesticide residue in our general food supply is continually increasing. However, available evidence suggests that so such progression has actually occurred. There was not any significant change in the storage of DDT in the general population in the United States between 1950 and 1962.

There are no recorded instances in which application of pesticide according to recommendations has resulted in seizure of the crop for excessive residue. Usually, when an excessive amount of residue is found on a crop, there has been an obvious, gross disregard of recommended practice regarding the amount or timing of the pesticide application, or both. A reasonable safety factor is included in the recommendations for application. This is in addition to the safety factor of 100 or more which is taken into account in setting the tolerance value.

The provision in the pesticide tolerance regulations which the individual grower is most likely to violate relates to mixed residues.

As a consequence of direct treatment with insecticides or of ingestion of insecticide-contaminated forage crops or pasture, fat from meat animals may contain residues of these chemicals.

There have apparently been no surveys of market meat to determine the extent to which contamination with residues of pesticides occurs. However, Walker and his co-workers (1954), in studies of complete meals which are discussed in more detail below, found that, in general, foodstuffs containing meat, meat combinations, or butter had a relatively high content of DDT. Hayes et al, (1958) noted only very small quantities of DDT in "meatless" meals and the storage of only very small concentrations of DDT-derived materials in the adipose tissue of meat abstainers.

Abstract (continued)

Lactating animals that have been exposed also excrete the chlorinated hydrocarbons materials in the lipid moiety in their milk. Since milk is the primary food for infants and invalids who might be unusually susceptible to the effects of toxicants, the U.S. Food and Drug Administration has not granted a tolerance level higher than zero for residue of any pesticide in milk; although surveys have shown that a considerable proportion of the market milk shipments contain small but detectible amounts of pesticide.

Small-Scale surveys in 1948, 1949, and 1951 indicated that traces of DDT could be found in about 25 percent of market milk samples. In 1955, 62 percent contained pesticide residues when tested by bioassay. Members of the aldrin group (aldrin, dieldrin, and endrin) were not encountered, nor were heptachlor, chlordane, and toxaphene. In a follow-up survey in 1958, 33 percent of samples were found to have detectible contamination. An attempt was made to learn the source of the contamination for eight dairies whose milk showed substantial residues. Feeding of DDT contaminated corn silage was found to be responsible for the high residues in one producer's milk. The contamination in the cases of two other producers was attributed to the careless spraying of the dairy barns with a concentrated DDT solution by a commercial applicator.

It has been shown that some chlorinated hydrocarbon pesticides, including endrin can be detected in eggs following incorporation into the diet of laying hens. There have apparently been no surveys made of market eggs to determine their content of pesticide residue. However, Hayes et al. (1958) noted that dishes containing eggs contributed heavily to the DDT content of meatless meals.

The DDT and DDE content of complete, prepared meals from restaurants and institutions were determined by Walker and his co-workers (1954). Generally, those foodstufffs cooked in fat and those containing meat or butter were found to have a higher DDT content than other foodstuffs.

Water: The possibility of pesticide residues in potable waters must be considered in evaluation of the hazard to man. Pesticides may enter the water supply by direct, intentional application; by inadvertent drift into water from adjacent spraying operation; or, perhaps, more commonly, by washing from pesticide-treated areas within the watershed. Fortunately, the great susceptibility of fish to many of these insecticides gives an easy clue to the significant contamination of streams.

Utilizing the high toxicity of the newer synthetic pesticides to fish, the U.S. Public Health Service instituted a nationwide survey of fish kills as a means of detecting water pollution. In the first 4 months of this survey (June through September 1960) more than 200 individual reports of fish kills were received. In 76 cases (38 Percent), agricultural chemicals were implicated as the etiological agent (Cottam 1960).

Nicholson (1962) has made a very thorough study of the pesticide content of a river system which drains a 400-square-mile cotton-farming area of Alabama in which pesticides, particularly toxaphene, DDT, and lindane were extensively used. The level of pesticides in the water was not decreased by the municipal water-treatment process. Toxaphene was found in the water all year long, but heaviest concentrations coincided with application to the fields. The contamination was general throughout the watershed. The insecticides apparently ran off the land surface dissolved in water. No effects of these pesticides on aquatic life of the stream were noted.

Small quantities of toxic chemicals occur naturally in some foods.

Abstract (continued)

VI. Human poisoning cases from residues. a) Cases involving agricultural usage.

Two types of injury must be considered in assessing the health hazards of pesticide residues -- first, the possibility of an acute illness resulting from ingesting residues on a single day or in a few days; and secondly, the long-term effects that may accrue after ingesting small quantities of residues daily for many years. On the basis of our knowledge of the acute toxicity of the various pesticides to experimental animals and to man, and of the levels of the chemicals present as residues on food products, illness from short-term exposure would not be expected to occur. This conclusion is supported by epidemiologic evidence. Thus, there have been no known cases of illness in the United States from insecticide residues on food when formulations have been used according to directions (Hayes 1960). The same is true in the United Kingdon. However, there have been several instances in which insecticides used quite improperly on foods have led to acute poisoning soon after ingestion. The question of whether or not deleterious effects may result from long-continued ingestion of residues is more difficult to solve.

Available knowledge of modes of action of pesticidal chemicals makes it possible to look more effectively for incipient and minimal evidences of toxicity in occupationally exposed individuals and in the general population.

It is reassuring to note that the effect of the various pesticides studied on animals, including man, seems to follow a normal dosage response curve, meaning that small amounts are probably harmless while larger doses may produce poisoning. Although a number of the common pesticides, including DDT, are stored in the body, this storage is not indefinitely cumulative. With tolerated doses of DDT, man approaches storage equilibrium in about one year and does not store any more of the compound regardless of how long the dosage is continued.

Data bearing on the toxic hazard due to pesticide residues are available from studies in which the amount of residue present in various foods has been determined and from animal toxicity experiments, and may be available from use experience, human volunteer studies, and cases of poisoning due to accident or suicide attempt. Studies are more nearly complete for DDT than for any other pesticidal chemical. Results from each of these types of study seem to indicate that no significant hazard to human health exists from pesticide residues as they not occur in our diet in the United States. However, the majority of pesticides have been little studied in man, and--even for the better known ones-- there is no way to exclude the possibility that subtle dangers remain to be discovered.

Residues on food crops have caused poisoning in agricultural workers from occupational exposure. Quinby and Lemmon (1958) reported 11 episodes of poisoning from contact with parathion residues involving more than 70 persons.

Disease/Solid Waste
Abstracts

No. DSW-387

Author

W. C. Hueper

Title

Carcinogens in the Human Environment

Reference

Archives of Pathology

Doc. No. Contract No. Date issued

V. 71, 1961, pp. 237-267; 355-380

Abstract

Another group of man-made environmental carcinogens, however, of recent date, is constituted of a rapidly increasing number and variety of chemical and physical agents which are the products of the modern industrial development. These agents are by far the largest number of environmental carcinogens of the so-far-known environmental carcinogenic spectrum. These new industry-related carcinogens are, in part, highly potent agents. They are encountered in a considerable number of occupational activities, are ingredients or contaminants of consumer goods (food-stuffs, cosmetics, household goods, sanitary goods, medicines, etc.) and are pollutants of the general air, water, and soil (industrial wastes, residues of pesticides, radioactive fallout). Human exposure to these recognized environmental carcinogens occurs thus from various sources and at numerous opportunities. All these contacts to specific carcinogens as well as to all carcinogens add to the total carcinogenic load to which persons and population groups become subjected to different degrees and for various reasons....

While for most of these agents a conclusive proof of their cancer-producing action, and thus the existence of an actual cancer hazard from contact with these agents, is limited to occupational exposures...many of the non-occupational exposures to the modern industrial carcinogens by the general population must constitute a cancer hazard....

...All experimental carcinogens must be looked upon for the time being as "potential human carcinogens" until evidence to the contrary becomes available.

As long as human evidence is not on hand, experimental carcinogens remain merely suspect of exerting a cancerous action on man, i.e., they remain "potential human carcinogens." Any restrictive and precautionary measure which may be applied as a matter of common sense to such agents for the protection of the population, therefore,

Descriptors

carcinogens
health hazards
foodstuffs
sanitary goods
air
industrial wastes
arsenic
asbestos
aromatic amines
anthracene
soots
paraffin
ultraviolet radiation
carbamates
estrogens
environment
industry-related carcinogens
cosmetics
medicines
water
radioactive fallout
carcinogenic load
chromium
benzol
coal tar and pitch
mineral oils
petroleum waxes
nonoccupational exposures
aliphatic and aromatic epoxides
chlorinated hydrocarbons
cancers
consumer goods
household goods
pollutants
soil
pesticides
wastes
nickel
isopropyl oil
creosote
petroleum asphalt
ionizing radiations
epoxides
beta-propiolactone
Diethylene Glycol

Abstract (continued)

cannot be based on conclusive scientific facts but on incriminating circumstancial evidence. It would indeed be foolish and irresponsible, on the other hand, to lightly dispose of such potential cancer hazards as being "calculated risks" which must be tolerated as unavoidable by-products of normal living in an industrial economy.

Experiments with carcinogenic polycyclic aromatic hydrocarbons adsorbed to the surface of carbon particles (soot, carbon black) suggest that the carcinogenic potency of these carcinogenic compounds is reduced when these agents are administered in this form, especially when the carbon particles are of very small size, because the adsorbed hydrocarbons are not readily eluted and released for action from such particles by substances of the host organism, i.e., they have become biologically unavailable.

Any chemical which is capable of producing cancers of any type in any tissue or organ of any species when introduced by any route and in any dose should be considered as a potential human carcinogen until its innocuousness for man has definitely been established.

It is apparent that the establishment of safety limits on the basis of such experimental observations would be improper because (a) the human population often becomes exposed to the same agent from several sources; (b) it has contact with numerous environmental carcinogens which may exert a synergistic action, and (c) it sustains a degree of contact with these agents which neither can quantitatively or qualitatively be determined nor can be controlled effectively as long as it is present.

Additional but avoidable exposures may indeed increase the carcinogenic load, especially in sensitized or hypersensitive, metabolically abnormal persons, to a level at which the development of a cancer may ensue.

Many of the cancer hazards affecting the general population may have their origin in one or several industrially produced consumer goods or environmental industrial pollutants The irregular and variable epidemiologic scatter pattern of cancers of different types among members of different population groups and in various geographic regions is at least in part a reflection of the influence of significant local fluctuations in the qualitative and quantitative composition of the environmental carcinogenic spectrum upon the cancer panorama.

Although the degree of exposure to many of the carcinogenic components of consumer goods is of relatively low order as represented by the dose and potency of the carcinogens involved, it is important that contact with many of them is usually very frequent and for some of them starts with birth and may last almost uninterruptedly for 24 hours a day until death. Carcinogenic air and water pollutants are most prominent in this respect. Serious consideration concerning the degree of exposure to environmental carcinogens must, moreover, be given to the fact that the general population often has contact with many of these agents for several reasons, i.e., the same carcinogen, such as arsenic, may be present in the atmosphere as an air pollutant, in the drinking water as a water contaminant, in foodstuffs as a pesticide residue, in medicines, cosmetics, wood preservatives, herbicides and insecticides as an active ingredient, and in paints and inks as a pigment or coloring matter. A corresponding situation arises whenever exposure conditions exist

Abstract (continued)

entailing contact with several different carcinogens which are syncarcinogens, i.e., there is a summation of the carcinogenic effects exerted by the individual agents, or there may occur occasionally even an accentuation of the added individual carcinogenic effects above this level.

...Many foods daily consumed by the general public are contaminated with feed additives (estrogens, arsenicals) and pesticide residues of some type, such as arsenicals or chlorinated hydrocarbons. Only very fragmentary information is available as to the potential carcinogenic properties of a considerable number of these agents.

...Natural or industrial carcinogenic pollutants may enter the drinking water supply as well as be absorbed by and accumulated in vegetables, fruits, and food animals using water contaminated with such materials (arsenicals, selenium, radioactive substances, wastes from coke ovens, tar refineries, oil refineries, textile dyeing plants, paper manufactures, cellulose factories, domestic and industrial detergents and others).

The growing pollution of the human environment with chemical and physical agents associated with the modern industrial development poses serious problems to medicine, public health, sociology, economy, natural sciences, and technology.

Cancer hazards associated with exposure to these agents represent a segment of the general toxic health hazards connected with the production, distribution, and consumption of industrial products and the release of industrial wastes into the environmental air, water, and soil.

Descriptors (continued)

8-Hydroxyquinoline
Thiourea
Acetamide
Polymers
Selenium
pesticide residue
shortenings
surfactants
petroleum derivatives
Surfactants-Detergents
Thiouracil
Waxes
Beryllium
Iron
food additives
synthetic sweetners
humectants
drinking water
Tannic Acid
Thioacetamide
greases
Cobalt
classification
emulsifying agents
flavoring agents
preservatives

Disease/Solid Waste
Abstracts

No. DSW-388

Author

George M. Sternberg

Title

Sanitary Lessons of the War

Reference

The Philadephia Medical Journal

Doc. No.	Contract No.	Date issued
	pgs.1298-1303;1366-69	June 10 & 17,1899

Abstract

During the war with Spain during the first months typhoid fever, prevailed in many of our camps and claimed numerous victims. The noteworthy rise in the general dealth-rate from disease and in that from typhoid fever alone which occurred in August and September, was undoubtedly due to unsanitary conditions resulting from the hasty assembling of large bodies of undisciplined troops in our camps of instruction. The mortality from typhoid fever in our armies during the year ended April 30, 1899, has been more than 22 times as great as it was in our regular army during the decade immediately preceding the war period.

Unfortunately typhoid fever is endemic in nearly all parts of the United States, and when a thousand men are brought together from any section there is a fair chance that one or more of them are already infected with this disease. Unless these cases are recognized at the very outset the camp site is liable to be contaminated by typhoid excreta and the bacilli, through the agency of flies or in a desiccated condition carried by the wind, effect a lodgment upon food being prepared in the company kitchens and thus find their way to the alimentary tract of susceptible individuals.

The mode of origin and spread of typhoid fever in our camps is illustrated by a recent epidemic in the camp of the 8th Cavalry at Puerto Principe, Cuba. Major Walter Reed, Surgeon U.S.A., was sent at my request to make a special investigation with reference to the origin of this epidemic. The following quotation from his report shows that, as usual, this epidemic had its origin in a failure to promptly recognize the disease, and a consequent failure to disinfect excreta and to move the troops from the infected camp site.

I find that the disease was imported by this regiment into its Cuban camp, but was mistaken by the various medical officers on duty with the regiment for malarial remittent fever until the epidemic had reached serious proportions; that

Descriptors

typhoid fever
disease
excreta
food
malaria
dissemination
hospital
camps
sanitation
flies
kitchens
water-borne infection
stools
death-rate
troops
wind
disinfection
latrines
clothing

Abstract (continued)

it was clearly not due to water-infection, but was transferred from the infected stools of patients to the food by means of flies, the conditions being especially favorable for this manner of dissemination by reason of the close proximity of the picket lines to mess-tents and latrines. I also find that the lax methods of disinfection of stools and clothing of patients in hospital were additional sources of infection.

Disease/Solid Waste Abstracts

No. **DSW-**389

Author

J. W. Wolff

Title

The Relation of Animal Hosts of Parasitic Leptospires in the Netherlands with Human Leptospirosis

Reference

Trop. & Geogr. Med., I, (1965) 2-8

Doc. No. **Contract No.** **Date issued**

Abstract

In many parts of the country the sewer rat, Rattus norvegicus, has been found to excrete leptospires of the serotype icterohaemorrhagiae...the causal agent of Weil's disease. This is still the most frequent human leptospirosis encountered....

In all surveys, large differences were found in the infection rate in young and mature rats (from 3 percent in young animals to 40 percent and more in adults) and also considerable differences in infection rates were found in different areas.

These findings confirm reports from other parts of the world and show that R. norvegicus constitutes the major reservoir in nature of icterohaemorrhagiae serotypes of leptospires. Other rodents, such as R. rattus and Mus musculus have been found to excrete these serotypes only occasionally.

During the last decade, the decrease in the number of cases might have been caused by the improvement of urban and rural sanitation measures and by the repeated rat-eradication campaigns which have been carried out in several places.

A second host of parasitic leptospires is the field vole, Microtus arvalis, natural host of L. grippotyphosa.

Of interest is the fact that often in the area where patients were infected, the farmers complained of a marked increase in the number of field voles.

These flucuations in population densities are known to appear periodically in many rodent species. ...in Microtus arvalis,...maxima in population number among this species occur regularly with a mean periodicity of three years.

Leptospirosis in dogs (caused byeither L. icterohaemorrhagiae or L. canicola) can be a severe, sometimes lethal infection....

...A significant number of dogs in our country has experienced contacts with L. canicola and we can only wonder about the relatively scarcity of the human canicola infection in dog owners in our country.

Hedgehogs, Erinaceus europaeus, were found to be natural hosts of sertypoes of the australis and javanica groups, both parasitic leptospires which so far did not cause human infections in the Netherlands.

Descriptors

sewer rat	Rattus norvegicus	Weil's disease
sanitation	rat-eradication	Microtus arvalis

Disease/Solid Waste
Abstracts

No. DSW- 390

Author

E. A. Steinhaus

Title

Insect Microbiology

Reference

Comstock, New York

Doc. No.	Contract No.	Date issued
		1946

Abstract

The material in this book, when quoted, is identified in the text of the study report by page number.

Descriptors

Disease/Solid Waste
Abstracts

No. DSW- 591

Author

H. F. Schoof, F.A. Mail, and E.P. Savage

Title

Fly Production Sources in Urban Communities

Reference

Journal of Economic Entomology

Doc. No.	**Contract No.**	**Date issued**
V.47:245-53		Apr.1954

Abstract

Surveys of fly breeding sources were conducted in Charleston, West Virgina (1951 and 1952), Phoenix, Arizona (1951 and 1952), and Topeka, Kansas (1950).[1] This paper describes the findings obtained at Charleston, West Virginia, with limited mention of the data from Topeka, Kansas.

Since the Charleston area was subject to fly control measures, limited surveys were also conducted in the nearly untreated towns of Dunbar and St. Albans, West Virginia. Both cities were in the 8,000 population class and possessed a physical make-up similar to Charleston, with the exception that animal pens were encountered more frequently in the untreated communities. All blocks within the city were groupsed into socioeconomic sections which in turn were divided into homogeneous units of 10 to 20 blocks each.

To insure adequate coverage of all types of socioeconomic conditions, the survey blocks were classified.

Although numberous media such as fowl excrement, dog stools, sea food wastes, and dead animals yielded a higher percentage of positive samples in relation to the total number of the particular substrate located, the ubiquitous occurrence of garbage in the city overshadowed these as to over-all significance in fly production.

Dog stools and fowl droppings composed over two-thirds of the total positive excrement samples detected. Because of zoning restrictions, feces of the larger domestic animals were almost wholly absent. In the miscellaneous categories, meat, dead animals, and coffee grounds predominated.

In the garbage category, the amount and the infestation rate increased with the decline in premises sanitation but in the excrement and miscellaneous categories, the increase followed an irregular sequence. The business zone exhibited the highest infestation rate in garbage but contained fewer substrates than all but the high-class

Descriptors

urban areas
fly breeding
sources
socioeconomic conditions
fowl excrement
dog stools
sea food wastes
dead animals
garbage
feces
domestic animals
dead animals
coffee grounds
infestation rate
blow flies
house fly
horse manure
grass clippings
flesh flies
meat scraps
sanitation

Abstract (continued)

residential blocks. On a comparative basis, garbage produced the highest number of substrates per block inspection in all four socioeconomic categories. The principal species recovered from samples of contained garbage were the blow flies *Phaenicia sericata* and *Phaenicia pallescens*, and the house fly, *Musca domestica*. The blow fly group predominated in refuse stored in containers. Although *M. domestica* was found in 27.9 per cent of the positive garbage can samples, refuse under these conditions was much less readily infested with this species than when it was scattered on the terrain. The reverse was true with the blow fly species.

Dog stools were the most common excrement detected during the survey period. In this medium, *Sarcophaga* spp. predominated, maintaining a percentage infestation rate of 96 per cent for both survey years. *Sarcophaga* spp. also were the chief species produced from human feces (64.7 per cent) with house flies, *Ophyra* spp. and *Phaenicia sericata* also being detected therein. Fowl excrement served as a source of a host of species of which *Musca domestica* was predominant.

Household garbage (in containers and scattered) was the most frequent producer of positive substrates and represented more than 47 and 53 per cent of all positive substrates located during 1951 and 1952. The ubiquitous distribution and close proximity to human habitation of garbage makes it a major cause of the undesirable close association between *Musca domestica* and man.

It is apparent that garbage both as to prevalence and the rate of infestation was the most important fly producing source within the community. In addition, this substrate supported a wider range of species than any of the remaining media, as evidenced by the fauna of 22 different flies which were produced from garbage in containers.

These data conflict with the general statement in the literature that house fly production is chiefly the result of breeding in horse manure. Available evidence now indicates that in urban areas household garbage forms the prinicpal substrate for house fly production. Even in cities where horse excrement is available, *Musca domestica* may breed more readily in other fecal matter (e.g. chicken). Apparently the house fly has adapted itself more readily to the change in city conditions than has man's thinking in regard to a problem which is essentially man made.

The general findings again implicate *Musca domestica* as the species which possessed the widest range of adaptability with reference to development in different media.

Of the miscellaneous media, all except grass clippings provided suitable conditions for the development of 9 to 11 different species. *Musca domestica* was recovered most frequently from coffee grounds. As the degree of sanitation was lowered, the number of different substrates increased. For example, in the high class area where a high degree of premises sanitation existed, only six types of positive substrates were located during the survey. Of these substrates, garbage in containers and dog excrement accounted for 75 per cent of all positive substrates found. In the middle class residential area, garbage in containers and dog excrement were still the important media detected but an increase occurred in the number ofother positive substrates, such as grass clippings, dead animals, meat scraps, coffee grounds, etc.

In the residential areas characterized by a low degree of sanitation, the number of positive dog droppings decreased concurrently with an augmentation in

Abstract (continued)

the number of positive samples of human and fowl excrement. An appreciable increase in scattered garbage and other miscellaneous substrates also occurred in this area. Garbage and coffee grounds were the common breeding media in the business area.

References

[1] The Topeka surveys were preliminary studies of limited covereage.

Disease/Solid Waste
Abstracts

No. DSW- 392

Author

A.A.Hubert and H. J. Baker

Title Studies on the Habitats and Population of Leptotrombidium (Leptotrombidium) Akamushi and L. (L.) Deliensis in Malaya (Acarina: Trombiculidae)

Reference

The American Journal of Hygiene

Doc. No.	Contract No.	Date issued
V. 78, No. 2;pgs. 131-42		Sept.1962

Abstract

Most of the previous information on the distribution of trombiculid mites in Malaya had been obtained by trapping the rodent hosts. It has been assumed that the Leptotrombidium (Leptotrombidium) akamushi and L. (L.) deliensis found on these rodent hosts dwell in the same scrub-grassland habitat where the hosts were caught.

Audy and Harrison pointed out, in regard to akamushi and deliensis, that both forms may be found and readily distinguished on the same rat in Malaya and elsewhere.

Audy and Harrison (1) had reported L. (L.) deliensis on Rattus mulleri, a forest rat of Malaya, and suspected this to be related to "occult sanctuaries" of jungle tsutsugamushi. Traub, Frick and Diercks (12) reported isolations of Rickettsia tsutsugamushi from Malayan forest rats, R. Mulleri, R. sabanus and R. rajah and postulated a cycle of tsutsugamushi disease in the jungle. Isolations of R. tsutsugamushi from pools containing Laurentella audyi (designated at that time Euschongastia indica found on squirrels in the forest appeared to be a clue in the mystery of this disease in the jungle.

Summary and conclusions: By using rabbits as collectors of trombiculid mites and plate methods for collecting these mites, systematic studies of their distribution on the ground in Malaysia have begun. Larval forms of Leptotrombidium (L) akamushi and L. (L.) deliensis have been shown to exist on the ground in distinctly different habitats. L. (L.) akamushi is found in grassland and L. (L.) deliensis in relatively large numbers in forests. This latter fact considerably broadens the epidemiologic considerations of tsutsugamushi disease in Malaya.

Descriptors

trombiculid mites
rodent hosts
Leptotrombidium akamushi
L. deliensis
rats
vector
Eutrombicula alfeddugesi
scrub itch mites
mites
Rickettsia tsutsugamushi
Rattus rattus argentiventer
field rats
forest rats
Rattus mulleri
R. sabanus
R. rajah
grassland
forests
tsutsugamushi disease

References

[1] Audy, J. R., and Harrison, J. L. A review of investigations of mite typhus in Burma and Malaya, 1945-1950. Trans. Roy. Soc. Trop. Med. and Hyg., 1951, 44: 371-404.

[12] Traub, R., Frick, L. P., and Diercks, F. H. Observations on the occurrence of Rickettsia tsutsugamushi in rats and mites in the Malayan jungle. Amer. Jour. Hyg., 1950, 51: 269-273.

Disease/Solid Waste
Abstracts

No. DSW- 393

Author

William E. Collins

Title

Studies on the Transmission of Semliki Forest Virus by Anopheline Mosquitoes

Reference

Am. J. Hygiene

Doc. No.	Contract No.	Date issued
V.77: 109-113		1963

Abstract

The Semliki Forest virus (SFV) was first isolated from a group of Aedes abnormalis mosquitoes from Uganda (1), and later from Aedes argenteopunctatus collected in Portuguese East Africa (2). It belongs to groups A of the arthropod-borne viruses.

The virus has been shown to be transmitted by Aedes aegypti and by Aedes togoi.

Summary and conclusions: Anopheles quadrimaculatus and Anopheles albimanus mosquitoes were readily infected with Semliki Forest virus by means of the membrane feeding technique. Virus titers after 10 days of extrinsic incubation were as high as 8.0 mouse log ICLD $_{50}$ with over-all infection rates of 85 to 90 per cent.

Transmission of the virus to wet baby chicks was obtained after extrinsic incubation periods of 6 to 17 days.

Infection of A. albimanus by feeding on SFV infected mice with subsequent transmission of the virus to baby chicks by mosquito feeding has been demonstrated.

Descriptors

Semliki Forest virus
Aedes abnormalis
Aedes argenteopunctatus
arthropod-borne viruses
Aedes aegypti
Aedes togoi
Anopheles quadrimaculatus
Anopheles albimanus
mosquitoes

Disease/Solid Waste Abstracts

No. DSW- 394

Author

Harry D. Pratt and Kent S. Littig

Title

Lice of Public Health Importance and Their Control

Reference

Communicable Disease Center, Atlanta, Ga.

Doc. No.	Contract No.	Date issued
PHS.772 pt.8		1961

Abstract

Louse-borne relapsing fevers have occurred in epidemic proportions in parts of Europe, Africa, and the Orient. The causative agents are spirochetes, Borrelia recurrentis and related species.

The louse remains infective for life. The disease is not transmitted to humans by bite or by the feces. The disease is acquired only by crushing a louse or damaging it in some way to allow its blood to contaminate skin or mucus membrane of a human being. The mobile spirochete then gains entrance through minor abrasions in the skin or membrane.

Other types of relapsing fevers are transmitted by ticks in the genus Ornithodoros in western United States, the Mediterranean region, Africa, and Asia. These are caused by spirochetes in the genus Borrelia, most of which are specific for the particular tick vector.

The rat louse, Polyplax spinulosa (Burmeister) is of almost world-wide distribution. It often occurs in great numbers on domestic rats throughout United States (Pratt and Good, 1954). This louse is readily infested with murine typhus rickettsiae (Mooser et al. 1931) and is capable of transmitting the disease from rat to rat in nature. This louse may be a vector of disease in rats but not in man, as it is not known to feed upon human beings.

Hoplopleura oenomydis Ferris is common on domestic rats in the South. Nothing is known regarding this species' possible relation to murine typhus. Two other species of lice, H. acanthopus and H. hirsuta are occasionally found on rats.

Descriptors

relapsing fevers
Borrelia recurrentis
louse
ticks
Ornithodoros
Borrelia
rat louse
Polyplax spinulosa (Burmeister
domestic rats
murine typhus
rickettsiae
vector
Hoplopleura oenomydis Ferris
murine typhus
H. acanthopus
H. hirsuta

Disease/Solid Waste
Abstracts

No. DSW- 395

Author

Harold George Scott and Kent S. Littig

Title

Flies of Public Health Importance and Their Control

Reference

Communicable Disease Center, Atlanta, Ga.

Doc. No.	Contract No.	Date issued
PHS 772, pt.5		1962

Abstract

Domestic flies can be a serious threat to individual efficiency. In a fly-infested office, the senior author has observed employees spending over 50 percent of their time swatting and driving away flies. Biting flies disrupt picnics and other recreational activities as well as the pioneering efforts of mankind.

The stable fly is common around human inhabitations and its bite can be quite severe. Black flies bite viciously, often attacking in such large numbers that they kill the victim. Deer flies, horse flies, sand-flies, punkies, and other biting flies attack man and cause him great discomfort. In susceptible individuals, the bites may produce severe lesions, high fever and even general disability (West 1958).

Myiasis: Many species of flies are capable of laying eggs or larvae on the flesh of mammals and other animals. The larvae thus deposited can invade the flesh of the host animal producing a condition known as myiasis.

Many flies, particularly the house fly and other domestic flies, have filthy habits which make them efficient mechanical vectors of disease. As a typical example: A house fly feeds on human feces in a privy used by a typhoid carrier, and then feeds on meat salad being prepared in a restaurant. The fly inoculates the food with pathogenic bacteria (including Salmonella typhi, the typhoid bacillus) which multiply rapidly in this ideal medium. When, hours later, the meat salad is eaten, the restaurant customers become infected, and develop typhoid fever.

Diseases transmitted mechanically by domestic flies (such as the house fly) include typhoid, paratyphoid, cholera, bacillary dysentery, infantile diarrhea (Verhoestraete and Puffer, 1958) amoebic dysentery, giardiasis, pinworm, roundworm, hookworm, and tapeworms (Hale, et al., 1960). Diseases transmitted mechanically by rasping flies (such as the eye-gnat) include trachoma, concjunctivitis, and yaws.

Descriptors

stable fly
black flies
deer flies
horse flies
sand flies
punkies
myiasis
vectors
house fly
typhoid
Salmonella typhi
paratyphoid
cholera
Bacillary dysentery
infantile diarrhea
amoebic dysentery
giardiasis
pinworms
roundworm
whipworm
hookworm
tapeworm
trachoma
conjunctivitis
yaws
anthrax
tularemia
leishmaniases
onchocerciasis
loiasis
bartonellosis
sandfly fever

Abstract (continued)

Diseases transmitted mechancially by biting flies (such as the deer and horse flies) include anthrax and tularemia (Lindsay and Scudder, 1956; DeCoursey and Otto, 1956; Knuckles, 1959).

Many flies, particularly biting flies, are involved in the biological transmission of some of the most serious and commonest of vector-borne diseases such as African sleeping sickness (Ashcroft, 1959) and the leishmaniases (Deane, 1959). Other diseases transmitted biologically by flies include onchocerciasis (blinding filariasis) loiasis (African eye-worm disease) bartonellosis (oroya fever) and sandly fever.

No. DSW- 396

Author

Jack H. Kimball

Title

Orange County Keeps Citizens "Mosquito Conscious"

Reference

Pest Control

Doc. No.	Contract No.	Date issued
33(8):28,30,32,34,37,40		1965

Abstract

Several state parks and institutions have their peculiar type of chronic breeding sources. Orange, with its public parks, an industrial farm, trash disposal operations, and 555 miles of county-maintained highways has many facilities for the use and disposal of water. At present, seven sewage treatment plants, with a total capacity of 3.5 million gallons daily, are disposing of treated effluent by land. Provisions have been made to expand these facilities to 23 mgd., and to use the effluent for irrigation of golf courses, greenbelts, and agriculture with future development of recreational lakes and even ground water replenishment. Catch mbasins and storm sewer inlets, certain paved gutters with flat grade, roadside ditches, culverts, siphons, and storm water lift stations must be sprayed at grequent intervals.

Breeding sources within the drainage facilities are perpetuated by accumulation of small quantities of community waste water resulting from irrigating lawns, washing sidewalks and streets, testing fire hydrants as well as from actual fires, pumping out swimming pools and, in suburban areas, from irrigation of citrus groves and other agricultural operations. Natural breeding sources are creeks and ravines; natural depressions and other low areas; and salt marshes.

Potential sources as ornamental pools, plastic swimpools, decorative vases, buckets, jars, cans, old tires, boats in storage, animal watering containers, and almost anything that will hold water for a week or more.

Descriptors

breeding sources
salt marsh mosquito
Aedes squamiger
waste
house mosquitoes
Culex peus
Culex quinquefasciatus
Culex tarsalis
pasture mosquito
Aedes nigromaculis
Aedes taeniorhyncus
winter mosquito
Culiseta inornata
Aedes sierrensis
treehole mosquito
Aedes increpitus
Aedes melanimon
pasture mosquito
Anopheles occidentalis
Anopheles franciscanus
Anopheles freeborni
malaria
Culex pipiens
Culex quinquefascinatus
Culiseta incidens
Culiseta particeps

Disease/Solid Waste
Abstracts

No. DSW- 397

Author

Harry D. Pratt, Ralph C. Barnes, Kent S.Littig

Title

Mosquitoes of Public Health Importance
and Their Control

Reference

Communicable Disease Center, Atlanta, Ga.

Doc. No.	Contract No.	Date issued
PHS 772, pt.6		1963

Abstract

Mosquitoes cause great suffering and economic loss because of their blood sucking habits. They are vectors of malaria, yellow fever, dengue, and filiariasis. Epidemics of three types of encephalitis continue to occur in many parts of this country and are the most important mosquito-borne diseases in the United States today. Pest mosquitoes are important to human health as their continued annoyance affects physical efficiency and comfort, mental equanimity, and the enjoyment of life (Bradley, 1951).

Mosquito bites may itch for days, some people suffering restlessness, loss of sleep and serious nervous irritation. Hess and Quinby (1956) have shown that mosquitoes often cause serious economic loss through restriction of man's outdoor activities. The cost may be measured in loss of recreation, milk and beef production, and the production of crops.

On a worldwide basis the various types of malaria are the most important of the human diseases.

Beginning in 1958 less than 100 cases of malaria have been reported each year for the entire United States, most of them contracted overseas, with only 3 or 4 primary indigous cases reported in 1961 and 1962.

The various types of malaria caused by parasites of the genus Plasmodium, which are transmitted from person to person by the bite of Anopheles mosquitoes. Although there are 15 Anopheles species in the United States only two seem to be important in malaria transmission: A. quadrimaculatus east of the Rockies and A. freeborni west of the Rockies.

Classical urban yellow fever is transmitted from man to man by the yellow fever mosquito, Aedes aegypti. Although no epidemics have occurred in the United

Descriptors

mosquitoes
vectors
malaria
yellow fever
dengue
filariasis
encephalitis
Anopheles
yellow fever
Aedes aegypti
dengue fever
Eastern encephalitis
Culiseta melanura
Aedes sollicitans and vexans
Mansonia
Western encephalitis
Culex tarsalis
Culex nigripalpus
Culex quinquefasciatus
C. pipiens
Aedes polynesiensis
Anopheles gambiae
Mansonia
Anopheles quadrimaculatus
Anopheles Freeborni

Abstract (continued)

States since the outbreak at New Orleans in 1905 and no major epidemic has occurred in the Americas since 1942, *Aedes aegypti* has been eradicated from most of the Americas south of the Rio Grande.

Jungle yellow fever, also called sylvan or sylvatic yellow fever, is normally a disease of monkeys. The occasional human cases are contracted when people in the forest are bitten by infected mosquitoes. *Haemagogus spegazzinii* falco, a tree hole breeder, appears to be the major vector in South America, being replaces by *Aedes leucocelaenus clarki* and other species in Central America and parts of South America.

Dengue fever is transmitted from person to person by the yellow fever mosquito, *Aedes aegypti*. The cycle is similar to that of urban yellow fever. *Aedes albopictus* is also an important vector in Hawaii, the Philippines and Southeast Asia.

Eastern, Western, and St. Louis encephalitis are caused by different viruses. These are transmitted normally from bird to bird, and less commonly from bird to man or his domestic animals, by a number of species of mosquitoes.

Eastern encephalitis occurs commonly in horses and pheasants. *Culiseta melanura* is a suspect vector along with *Aedes sollicitans* and *vexans* and *Mansonia perturbans*.

Western encephalitis iskfound in all of the states west of the Mississippi and in Wisconsin and Illinois. It has been found in limited areas further east in birds and mosquitoes. There were many noteworthy outbreaks in horses in the 1930's. The largest human outbreak involving over 3,000 persons occurred in 1941. Another large epeidemic occured in California in 1952. *Culex tarsalis* is the most important vector.

Members of the *Culex pipiensquinquefasciatus* complex are the chief urban vectors. *Culex tarsalis* is the chief vector in some western states, particularly on the Pacific coast. Epidemics occurred in the Tampa Bay area of Florida in 1959, 1961, and 1962. *Culex nigripalpus* was probably the vector in Florida.

These three types of encephalitis are generally considered to be viral diseases in which birds serve as natural hosts and mosquitoes as the most important vectors. According to Hess and Holden (1958) the basic transmission cycle from bird to bird is maintained by mosquitoes with the human and horse cases considered as accidents and dead-end hosts in the chain of infection.

Donaldson (1958) listed the following needs as most important toward a definitive program for the control of arthopod-borne encephalitides.

1. Continuing appraisal of the true public health importance of the arthropod-borne encephalitides.
2. Comprehensive understanding of the epidemiology.
3. Improved diagnostic tools, procedures and resources.
4. Development of effective and practical methods of control.

Human cases of filariasis are caused by the nematodes, *Wuchereria bancrofti* and *Brugia malayi*. The disease is not now known to be naturally acquired in the United States.

Napier and other Indian workers believed that the filarial worms would develop in the mosquito only in areas where the mean temperature is 80°F. or above with a relative humidity of 60 percent. If this is true, only a relatively small area of the United States--those states bordering the Gulf of Mexico, Georgia, and

Abstract (continued)

South Carolina--is favorable for the establishment of filariasis.

The young filarial worms are transmitted from person to person by various species of mosquitoes. Some important known vectors of W. bancrofti are *Culex quinquefasciatus*, *C. pipiens*, *Aedes polynesiensis*, and *Anopheles gambiae*. The generally accepted vectors of *Brugia malayi* are mosquitoes in the genus *Mansonia*.

Anopheles quadrimaculatus (The common malria mosquito). This species is the most important vector of malaria in the United States. *A. quadrimaculatus* breeds chiefly in permanent fresh water pools, ponds, and swamps which contain aquatic vegetation or floating debris. It is most abundant in shallow waters. In some areas it appears to favor open sunlit waters while in others it is found in densely shaded swamps. This species shows a preference for clear, quiet waters which are neutral to alkaline and does not usually occur where the pH is lower than 6[illegible] Breeding seldom occurs in stagnant waters heavily polluted with plant or animal matter. Some of the common habitats are lime-sink ponds, borrow pits, sloughs, bayous, sluggish streams and shallow margins and backwater areas of reservoirs and lakes (King, Bradley, and others, 1960).

Anopheles Freeborni (The Western Malaria Mosquito). *A. freeborni* breeds in permanent or semipermanent waters which are at least partially exposed to the sunlight, and contain vegetation or flotage. It has for the most part adapted itself to seepage areas, borrow pits, hoof prints, improperly irrigated fields and the edges of streams and irrigation canals.

The genus *Aedes* contains more than 500 species distributed from the Polar regions to the Tropics. Almost one-half of all North American mosquitoes belong to this genus which includes many of our major pest species as well as important disease vectors.

Breeding places for species of *Aedes* are extremely variable. In general they breed in temporary pools formed by rains or melting snows. Some species breed in the coastal salt marshes which are flooded at intervals by unusually high tides. Others have become adapted to irrigation practices. A few species breed in tree holes, rock pools, and artificial containers.

Aedes Aegypti. It is the vector or urban yellow fever and dengue. *Ae. Aegypti* is thoroughly domesticated, breeding almost exclusively in artifidal containers in and around human habitations.

The genus *Culex* includes about 300 species most of which occur in the tropical and subtropical regions of the world. Some 26 species have been reported in the United States although only 12 of these are at all common. The group includes several important pest species and disease vectors.

Culex mosquitoes breed in quiet waters of almost all types from that in artificial containers to large bodies of permanent water. Water in which there is considerable organic material including sewage is often a favored breeding place. *Culex nigripalus* is the proven vector of St. Louis encephalitis virus in the Tampa Bay outbreak in 1962.

C. pipiens, the northern house mosquito, occurs throughout northern United States extending as far south as Georgia and Oklahoma. *C. quinquefasiatus*, the southern house mosquito, occurs in all the Southern States from coast to coast and extends northward to Nebraska, Iowa, Illinois, and Ohio. One or both of these species will probably be found in every one of the States. Members of the *Culex pipiens-quinquefasciatus* complex are important vectors in urban epidemics of St. Louis encephalitis, particularly in the Midwest.

Abstract (continued)

C. pipiens and C. quinquefasciatus breed prolifically in rain barrels, tanks, tin cans, and practically all types of artificial containers. These species do not migrate far except when great numbers are being produced.

Culex Tarsalis is believed to be the most important vector of encephalitis to man and horses in the Western States, according to Ferguson. It is essentially a rural mosquito. C. Tarsalis varvae utilize almost all types of water. These include canals, ditches, borrow pits, impoundments, ground pools, and hoof prints. Artificial containers of various types such as cans, jars, barrels, drinking troughs, ornamental ponds, and catch basins. C. tarsalis will fly at least 10 miles, although the majority of individuals probably remain within a mile of their breeding places.

The culiseta group. Two species have been found [illegible] nfected with encephalitis virus but their relation to the epidemiol[illegible] iseases is not known.

No. DSW- 398

Author

Harry D. Pratt and John S. Wiseman

Title

Fleas of Public Health Importance and Their Control

Reference

Communicable Disease Center, Atlanta, Ga.

Doc. No.	**Contract No.**	**Date issued**
PHS 772, pt.7		1962

Abstract

Fleas are of great importance as vectors of disease in many parts of the world. Public health workers are most concerned with fleas that carry the organisms of bubonic plague and murine typhus from rats to man and those that transmit plague among wild rodents and occasionally to man. However, many people are more concerned with fleas because of their insidious attacks on man and domestic animals, causing irritation, loss of blood, and extreme discomfort. In addition, fleas are known to serve as intermediate hosts for some species of dog and rodent tapewors that occasionally infest man, and they may act as intermediate hosts of a filarial worm of dogs. Fleas may possibly be involved as vectors of Salmonella bacteria causing diarrhea and dysentery and of the bacteria causing tularemia.

Pratt (1958) has written that murine typhus has practically disappeared from many large cities and has experienced a dramatic drop in incidence throughout the United States coincidental with vigorous control measures. While the great majority of reduction in the number of murine typhus cases is probably due to rat killing and DDT-dusting to kill infected fleas, McCrean and co-workers (1955) believe that some of the decreased morbidity may be due to use of new antibiotics such as aureomycin and terramycin. These authors have written, "The reporting of all rickettsial infections has been adversely affected by the availability of effective chemotherapeutic agents. The rickettsial infections are so well masked by antibiotics that many cases are avoided and diagnosis with complete laboratory confirmation is a rarity." Continued progress in controlling rats and rat ectoparasites should prevent further build-ups of the disease. Murine typhus control is based on the control of domestic rats and mice and their fleas.

Salmonellosis. Meat and other foods contaminated by unsanitary conditions, including infective feces of rats and mice, are generally considered to be the

Descriptors

fleas
plague
murine typhus
rats
wild rodents
dysentery
tularemia
oriental rat
Xenopsylla cheopis
northern rat flea
Nosopsyllus fasciatus
Salmonella
Salmonellosis
Salmonella enteritidis
Leishmaniasis
Trypanosomiasis
Relapsing fever
dematitis
allergy
ground squirrel flea
Diamanus montanus
ground squirrels
Nosopsyllus fasciatus
Hoplopsyllus anomalus
squirrel flea
Orchopeas howardii
mouse flea
Leptopsylla segnis
house mouse
Mus musculus
The cotton rat flea
Polygenis gwyni
cotton rat
Sigmodon hispidus

Abstracts (continued)

prime source of human infections. It is possible that human infection can be contracted directly from the bite of an infected flea or from foodstuffs contaminated with their feces.

Other diseases. Fleas have been mentioned as vectors of the following diseases:

Tularemia. Fleas can become infected with tularemia organisms and remain carriers of the bacteria (Pasteurella tularense) for a month or more, but they are probably not important vectors. In the United States the following species of fleas have been found naturally infected with the bacteria: Diamanus montanus, Cediopsylla inaequalis, C. simples, Nosopsyllus fasciatus, and Thrassis bachi.

Leishmaniasis. Fleas have been reported as fectors of infantile and canine leishmaniasis in the Mediterranean region but Chandler and Read (1961) did not believe that they were involved in the transmission of these diseases.

Trypanosomiasis. Fleas transmit the non-pathogenic trypanosome (Trypanosoma lewisi) of the rat. However, the causative agent of Chagas' disease (T. cruzi) undergoes rapid degeneration in the flea (Chandler and Read, 1961).

Relapsing Fever. Chandler and Read (1961) asserted that the spirochetes of of relapsing fever do not develop in the flea.

Miscellaneous. To the list of disease entities in which fleas may play some role, Jellison (1959) added myxomatosis, a disease of wild and domestic rodents; anemia due to exsanguination; dermatitis or flea allergy; and Tunga infestation, a special pathological condition.

The Ground Squirrel Flea, Diamanus montanus, is capable of transmitting plague among wild rodents.

Hoplopsyllus anomalus is a major ectoparasite of ground squirrels (Citellus), and is a proven vector of plague.

The Northern rat flea, Nosopsyllus fasciatus, is commonly found on domestic rats and house mice throughout North America and Europe. It is the predominant rat flea in the northern United States. This species may be of importance in transmission of plague organisms from rat to rat. It has been taken from wild rodents on a few occasions.

The squirrel flea, Orchopeas howardii, is found commonly in eastern United States, and also in the west, wherever gray squirrels occur. It is sometimes a serious household pest if these squirrels build their nests in attics and are later killed or excluded from the house by rodent stoppage. In such cases, the fleas which breed in the next material, attack people in the attic or invade other parts of the building.

The mouse flea, Leptopsylla segnis, is most commonly found on domestic rats throughout the Gulf States and in parts of California, and less commonly on the house mouse, Mus musculus. It is considered to be a poor vector of murine typhus. It can be infected with plague in the laboratory, and has been found naturally infected with murine typhus in China.

The cotton rat flea, Polygenis gwyni, is a parasite of the cotton rat, Sigmodon hispidus, in the southeastern and southwestern states. Specimens have been taken on the Norway rat, dog, and opossum. This species is one of the most efficient plague vectors among North American rodent fleas (Holdenreid, 1952).

Disease/Solid Waste
Abstracts

No. **DSW-** 399

Author

Harry D. Pratt

Title

Mites of Public Health Importance and Their Control

Reference

Insect Control Series
U.S. Dept. of Health, Education & Welfare

Doc. No.	**Contract No.**	**Date issued**
PHS 772, pt.9		1963

Abstract

Mites are imporatnt to man because they are associated with:

Scabies or mange-like conditions, produced primarily by mange or itch mites in the families Sarcoptidae, Psoroptidae, and Demodicidae.

Transmission of disease-causing organisms, primarily of our groups: (1) viral diseases, such as encephalities by certain bird mites; (2) rickettsial diseases, such as scrub typhus by chiggers in the Pacific area of the Old World, rickettsialpox by the house mouse mite and possibly murine typhus by the tropical rat mite; (3) bacterial diseases, such as tularemia by the tropical rat mite in the laboratory or epidemic hemorrhagic septicemia by the snake mite, and (4) filarial disease of the cotton rat by the tropical rat mite.

Dermatitis, caused primarily by direct attack of chiggers in the family Trombiculidae, bird and rat mites in the family Dermanyssidae, straw itch mites in the family Pyemotidae, and by contact with cheese mites in the families Acaridae and Glycyphagidae.

Annoyance and invasion of buildings, without causing dermatitis or transmitting any disease-causing agent, by the clover mite.

Infestation of the lungs, intestine, or urinary passages, as the lung mites or certain cheese mites.

Tapeworm infestations of domestic animals as some beetle mites serve as intermediate hosts for certain tapeworms.

Descriptors

mites
scabies
Sarcoptidae
Psoroptidae
Demodicidae
viral diseases
encephalitis
rickettsial diseases
scrub typhus
rickettsialpox
house mouse mite
murine typhus
bacterial diseases
tularemia
dermatitis
rat mites
tapeworm infestations